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NOTES ON AMERICAN WILLOWS. X ¹

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BEFORE I can prepare a key and an enumeration of all the American Willows I have to discuss several more species. Most of them may be referred to the sections *Fulvae* and *Roseae*. Much doubt, however, exists as to the systematic position and the real relationship of some species.

There is yet another group I have not dealt with, namely, the section *Cordatae*, but as I have repeatedly stated, I have not studied this group sufficiently because Mr. C. N. Ball is already writing a monograph on it.²

To-day I can only refer to what I said in the introduction to my last note on the incompleteness of our present knowledge of most of the species and varieties, and on the collections on which I have mainly based my studies. All I can do here is to try to stimulate the interest in the study of Willows. Investigations like those of Griggs³ on the species of Ohio would greatly help us, especially if careful attention is paid to the existing literature on this subject. A critical review of the treatment of the genus given in such books as Britton & Brown's *Illustrated Flora*, Britton's *Manual*, Gray's *New Manual*, Rydberg's *Flora of the Rocky Mountains*, Jepson's *Flora of California*, Howell's *Flora of the Northwest Coast* and others would be of great value but it cannot be done successfully until we are able to interpret more correctly certain species, their relationship and variability.

a. THE SPECIES OF SECTION FULVAE.

This section was proposed by Barratt in 1840 for *S. rostrata* Richardson. He gave a good description of its main characters, and said that it is "nearer allied to some of the European, than any of the American Willows, known to me." Andersson, in 1858 and later, placed the species of this section in his section *Cinerascentes* vel *Capreae*, and I too, in 1904, referred

¹ Our attention has been drawn by Professor J. C. Nelson to an error on p. 162 of vol. I of this Journal in regard to Coville & Applegate's No. 551 of *Salix commutata* which is enumerated under the state of Washington, but should be referred to Oregon, the locality being near the line between Lane County and Crook County or probably, after the subdivision of this county, Deschutes County; the date should read August 17, not 7. Ed.

² Mr. Ball's study of the section *Cordatae* is expected to appear in the next issue of this Journal. Ed.

³ Griggs, R. F. The Willows of Ohio. (Proc. Ohio State Acad. Sci. vi. pt. 6, pp. 60. 1905.)

S. Bebbiana to the *Capreae*. Both sections, however, are quite distinct, and Ball, in 1909, made a new section *Rostratae* for *S. Bebbiana* and *S. Geyeriana*, apparently overlooking Barratt's name *Fulvae*.

From those of section *Discolores* (see my note ix) the species of the *Fulvae* chiefly differ in their yellowish or light brown scales with a short thin pubescence, their more slender and lax aments, their comparatively longer pedicels and shorter stigmas. They show a closer relationship to the species of section *Griseae* also treated in my last note. Species like *S. humilis* and *S. tristis* with their rostrate capsules are, perhaps, better placed in a separate section because they differ as much from the true *Griseae* (*S. sericea* and *S. petiolaris*) as from the *Fulvae*, the species of which also have rostrate fruits. The taxonomic value of certain characters in a genus like *Salix* can be interpreted very differently, and I shall later explain how much at variance the opinions of our best salicologists really are.

The synonymy of section *Fulvae* is as follows:

Sect. *Fulvae* Barratt, Sal. Am. sect. VII (1840). — Sect. *Cinereae* Borrer apud Hooker, Fl. Bor.-Am. II. 144 (1838), pro parte, quoad *S. rostratam*. — Sect. *Cinerascetes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 122 (1858), pro parte. — Sect. *Cinerascetes* vel *Capreae* Andersson in Svensk. Vet.-Akad. Handl. VI. 57 (Monog. Salic.) (1867), pro parte; in De Candolle, Prodr. XVI.² 215 (1868), pro parte. — Sect. *Capreae* Schneider, Ill. Handb. Laubholz. I. 61 (1904), pro parte, non Koch. — Sect. *Rostratae* Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909).

1. *S. Bebbiana* Sargent in Garden & Forest, VIII. 463 (1895); Silva, IX. 131, t. 477 (1896). — Schneider, Ill. Handb. Laubholz. I. 61, fig. 11 w-w², 12 s (1904). — Britton & Brown, Ill. Fl. ed. 2, I. 599, fig. 1471 (1913). — *S. rostrata* Richardson, Bot. App. in Franklin, Narr. Jour. Polar Sea, 753 (1823); reprint, 25; ed. 2, 765 (1823); reprint, 37; non Thuillier (1799). — Hooker, Fl. Bor.-Am. II. 147 (1839). — Barratt, Sal. Am. No. 25 (1840). — Torrey, Fl. N.Y. II. 211 (1843). — Carey apud Gray, Man. ed. 1, 428 (1848). — Bebb apud Gray, Man. ed. 6, 482 (1890). — *S. fusca* Hooker, Fl. Bor.-Am. II. 151 (1839), sec. specim. orig., non Linnaeus — *S. vagans* 1. *cinerascens* b. *occidentalis* Andersson in Öfv. Vet.-Akad. Förh. xv. 122 (1858), quoad pl. americ. — *S. vagans* 1. *S. rostrata* Andersson in Svensk. Vet.-Akad. Handl. VI. 87 (Monog. Salic.) (1867), quoad var. *obovata*, exclud. formis. — *S. vagans occidentalis* Andersson, l. c., pro syn. subspec. *rostratae*. — *S. livida occidentalis* Gray, Man. ed. 5, 464 (1867). — *S. vagans* β *rostrata* 3. *obovata* Andersson apud De Candolle, Prodr. XVI.² 227 (1868). — *S. depressa* c. *rostrata* Seemen in Ascherson & Graebner, Syn. Mitteleur. Fl. IV. 119 (1909).

This species was first described by Richardson (1823) as *S. rostrata*. The type came from the "wooded country from lat. 54° to 64° north." In the herbarium of the New York Botanical Garden there is Richardson's specimen from Fort Franklin (65°) which agrees with the author's description.

The same form is in Herb. Ottawa under No. 24749 (fruiting branchlets) bearing the label "*Salix Scouleriana* Fl. Bor. Am. Dr. Richardson." Bebb, in 1891, made the note to it: "ticket evidently misplaced." If it is, however, a specimen of Richardson's (ex Herb. Mus. Brit.) the name only may be a lapsus calami. On the same sheet there is also a sterile branchlet which is not described by Richardson. In his description everything fits the specimen in Herb. N. Here we find on the same sheet a female specimen collected by Richardson on July 20, 1827 "N.Y. House." According to Franklin (Narr. second Exp. Polar Sea, 315 [1828]) Richardson on July 8, 1827, was at Fort Alexander, Manitoba, whence he went to Montreal. Where he was on the 20th of July is not stated, and I have been unable to find out where "N.Y. House" is. The specimen is identical with that from Fort Franklin.

There is, however, in Herb. Ottawa another specimen collected by Richardson and labeled "*S. rostrata* Richards. Franklin Expedition, between Forts Simpson and Chepewyan" (Chapewyan on Franklin's map). This specimen has narrow elliptic-lanceolate leaves which soon become almost glabrous beneath, and glabrous branchlets. Richardson's statements "*folia sesquipollicaria, exstipulata, pube sericea caduca ? vestita subtus grisea sub-glaucula*" might refer to this glabrescent form. But if we take this specimen for the type, *S. rostrata* sensu stricto would be the same as our present var. *perrostrata*, and we should be obliged to take up the name var. *obovata* of Andersson for the eastern form which we at present regard as the type.

As I have not seen the material of the Hookerian Herbarium I use the name *Bebbiana (rostrata)* for the pubescent form which, however, is closely connected with var. *perrostrata* by numerous intermediate forms. Richardson's glabrescent specimen has rather thin, acute leaves which measure up to 4:1.2 cm. They are partly distinctly glaucescent beneath, the pubescence being very thin. The fruiting aments are old, the fruits measure about 8 mm., the pedicels about 4 mm. in length, and their pubescence is very thin.

Hooker, Barratt, Torrey and Carey used the name *S. rostrata* Richardson. When Andersson first dealt with the American Willows he named this species *S. vagans cinerascens occidentalis*. He cites Richardson, Gray and Hooker but he does not mention any specimens, and he also refers to it some Siberian forms. The quotation "*S. depressa cinerascens* Trautv." has been omitted in Sal. Bor. Am. 61. All the other forms of *S. vagans* given by Andersson in 1858 are of European origin. In 1867, he has a *S. vagans* 1. *S. rostrata* with the synonym *S. rostrata* Richardson and *S. vagans occidentalis* Andersson. This sub-species *rostrata* includes only American forms, and Andersson enumerates the following five varieties of it: *latifolia*, *lanata*, *obovata* (with forms *subambigua* and *subrepens*), *lanceolata* and *glabrescens*. To his second subspecies *cinerascens* Andersson, in 1867, does not refer American forms, but under his third subspecies, *S. livida*, we find a var. *americana* which is said to be connected by inter-

mediates with var. *glabrescens* of the subspecies *rostrata*. In 1868 Andersson reduced his subspecies to varieties, and we find under var. β *rostrata* only four forms: 1 *latifolia*, 2 *lanata*, 3 *obovata* (without any subform), and 4 *latifolia*; var. *glabrescens* of 1867 has been omitted.

Gray in 1867 used the name *S. livida occidentalis* for *S. rostrata*. Bebb, however, took up this name again in 1885 (in Coulter's Manual). Sargent, in 1895, changed the name *S. rostrata* to *S. Bebbiana* on account of the older *S. rostrata* Thuillier (Fl. Envir. Paris ed. 2, 517 [1797]). This new name has been accepted by several later authors. Robinson and Fernald (1909) keep Richardson's name, regarding *S. rostrata* Thuillier as a strict synonym. This name, however, is not an unconditional synonym (as for instance the name *S. longifolia* Lamarck, see Bot. Gaz. LXVII. 340). A. & E.-G. Camus (Class. Saul. d'Europe I. 163 [1904]) mention *S. rostrata* Thuillier in the synonymy of *S. repens* Linnaeus but again as a synonym of their var. *A. vulgaris* subvar. *microphylla*. Von Seemen (in Ascherson & Graebener, Syn. Mitteleurop. Fl. IV. 127 [1909]) refers Thuillier's name as a synonym to his *S. repens* B. *rosmarinifolia* thus regarding it as identical with a form different from that of Camus. It is, therefore, possible that Thuillier's name may be used again as a specific name, and as the case stands it seems not advisable to apply the name *S. rostrata* to an American species.

With regard to the variability of *S. Bebbiana* it ought to be said that the floral characters as a whole seem to be very constant. The length of the style varies to a certain degree but we should need the investigation of a very large series of well-developed female specimens to decide whether the forms with a more conspicuous style (almost equaling the length of the stigmas) can be regarded as distinct. Fernald's var. *projecta*, a still very little known variety, seems to be the only one of which the flowers differ somewhat from those of the type, but here, too, the differences are not very important. On the other hand the variability of the leaves is much greater but it is extremely difficult to limit varieties. Andersson, apparently, did not see copious material, and he was inclined to lay too much stress upon certain variations which look very distinct as long as intermediate forms are not seen. As I have already mentioned Andersson first considered *S. Bebbiana* as var. *occidentalis* of his *S. vagans* l. *cinerascens*. Later also he kept it as a variety of *S. vagans*.¹ I do not wish to-day to discuss the question whether the American *S. Bebbiana* is so closely related to any of the European-Asiatic forms which have been united under the name *livida*, *depressa* or *Starkeana* that it, too, must be regarded as a variety or a subspecies of it. I think it best to keep the American forms as a separate species.

As already explained, Andersson, in 1867 and 1868, established quite a number of forms of his subspecies or var. *rostrata*. It is strange that he also has besides *rostrata* which only consists of American forms another

¹ This *S. vagans* is the same as *S. livida* of Camus and *S. depressa* of Von Seemen. As I have tried to show the oldest name for this species is *S. Starkeana* Willdenow, see Sargent, Pl. Wils. III. 151 (1916).

American form under his subspecies or var. *livida* of which he, in 1867, says: "Ad formas denudatas *S. rostratae* attamen modificationes permultae adsunt transitoriae." This is his var. or f. *americana* of which the type was collected by Bourgeau "ad fluv. Saskatchewan." The var. *americana*, in 1868, is said to be characterized by "foliis magnis 2-3 poll. longis late lanceolatis v. subovali-obovatis grosse undulato-crenatis, primo tenuibus subtus partim glaucescentibus, demum rigidiusculis utrinque viridibus, nervis pallidioribus et prominenti-reticulatis pulchre percursis." He adds: "E regione ad fl. Saskatchewan plura specimina a Bourgeau lecta vidi." Among Bourgeau's specimens which I have seen none fitted this description. The statement that the leaves later become "utrinque viridibus" is rather strange. It is probable after all that var. *americana* does not belong to *S. Bebbiana*, and it is impossible to ascertain the identity of this variety without seeing the type.

"In *S. lividam americanam* aperte abiens" is Andersson's var. *glabrescens* of *rostrata*, the type of which, too, was found by Bourgeau on the Saskatchewan. From var. *americana* it "vix nisi foliis minutissime pubescentibus et forsan etiam majoribus differt." In 1868 this var. *glabrescens* is not mentioned by Andersson even as a synonym. One might be inclined to apply this name to what we now call var. *perrostrata* if there was not the statement that the leaves are rather larger than those of var. *americana*. Forms with such large leaves apparently do not belong to *S. Bebbiana* but to *S. discolor* or *S. balsamifera*. Only by a type specimen can the identity of the large-leaved form be established.

There remain to be discussed four more of Andersson's varieties of 1867. Of these var. *obovata*, according to the author is "forma typica. ubique in America septentrionali frequens." He distinguished two forms of it: f. *subambigua* and f. *subrepens*. The first is characterized by "foliis ovali-obovatis, rigidissimis, margine remote serrulatis, subtus lucide tomentellis." It was collected by Lyall "in Sumass-prairie." The second differs by "foliis lingulato-lanceolatis basi longe attenuatis, breve acuminatis, 1½ poll. longis, supra medium vix ½ poll. latis, subtus saepissime tomentosiss." Bourgeau found it in the Rocky Mountains. In 1868, both forms are mentioned again but without names, and Andersson here states "Ambae in Rocky mountains (Bourgeau)." I have not yet seen a specimen of Lyall's from Sumass Prairie or of Bourgeau's from the Rocky Mountains which agree with these descriptions, and I must regard at present the two forms as uncertain, while I take var. *obovata* for a synonym of typical *Bebbiana*.

A narrow leafed form of the type seems to be Andersson's var. *lanceolata* of which in 1867 he says: "foliis elongatis supra medium parum dilatatis, fere 2 pollices longis vix ¾ poll. latis, utrinque pilis adpressis incano-hirtis; amentis magis densifloris." He himself adds "foliis tantum angustioribus a praecedente [var. *obovata*] recedunt." The diagnosis of 1868 is somewhat different, and it is impossible to decide the identity and the taxonomic value of this variety without the type.

Among Lyall's specimens from the "Lower Frazer River" in the Kew

Herbarium is one which Andersson himself named "*Salix vagans cinerascens latifolia*." In 1867 and 1868 he, however, states that the type of *S. vagans cinerascens rostrata latifolia* was collected by Lyall "in ins. Vancouver." The description runs: "foliis $2\frac{1}{2}$ –3 poll. longis, supra medium 1– $1\frac{1}{2}$ poll. latis, longius acuminatis, tenuibus, subintegris, subtus molliter tomentosis; stipulis parvis acutissimis." I have not yet seen a specimen of *S. Bebbiana* from Vancouver Island, and Henry (Fl. South. Brit. Col. 98 [1915]) says of *S. Bebbiana*: "common east of the Cascades. Kamloops; Armstrong; Crows Nest Pass." It apparently does not grow on Vancouver Island. Therefore the type of Andersson's var. *latifolia* may belong to *S. Scouleriana*.

Of Lyall's specimens from the lower Frazer River before me none agrees with Andersson's var. or f. *lanata* which he, in 1867, characterizes as follows: "foliis ex ovato-subcordata basi ovali-oblongis, crassioribus, $1\frac{1}{2}$ poll. longis, integris, breve acuminatis, utrinque cinereo-sublanatis; capsulis magnis a basi latissima ovatis; ramis nudiusculis, junioribus fusco-tomentosis." In 1868 Andersson only says: "fol. ovato-subcordatis crassiusculis utrinque dense tomentosis." *S. Bebbiana* rarely has leaves with an ovate-subcordate base, and I have never seen young branches with a fuscous pubescence. On the other hand it seems hardly probable that Andersson misinterpreted this plant because he had seen the fruits. Otherwise one might believe that var. *lanata* should be referred to *S. Scouleriana* or some other species. After all Andersson's varieties and forms mostly are very uncertain. None of them can be regarded as really identical with one of the varieties discussed later.

As far as I can judge by the material I have seen there are two main variations: the typical *S. Bebbiana* (*S. rostrata* Richardson sensu stricto) which is found in the north and east, and a western-southwestern variety agreeing with Rydberg's *S. perrostrata*, and chiefly differing from the type by its smaller, smoother leaves glabrescent below. In his original description of *S. perrostrata* Rydberg does not state the differences between it and *S. Bebbiana*. In 1906 (and 1917) Rydberg says of *S. perrostrata*: mature leaves "thin, glabrous, faintly nerved," and of *S. Bebbiana*: "mature leaves firm, pubescent or tomentose beneath, more strongly nerved." These statements do not prove correct. The texture and nervation are often much alike in both varieties, and only by the glabrousness and by the general impression of the plant is it possible to decide whether it should be referred to the type or to var. *perrostrata*.

The type of *S. perrostrata* came from the Black Hills in South Dakota where it had been collected by Rydberg (No. 1018) near Hermosa in 1892. Rydberg also referred to it a specimen collected by R. S. Williams at Dawson, Yukon Territory. Coville (1901) said: "While his bibliographical references indicate that the species is a segregate of *bebbiana*, the author gives no comparison of distinguishing characters. I am unable to find in his description anything to distinguish our Alaskan specimens from what I take to be typical *bebbiana*, whatever may prove to be the relation of

that species to the Black Hills willow." I have seen a great number of specimens from the Yukon Territory collected by Miss Eastwood which partly can be regarded as var. *perrostrata*, and partly can hardly be distinguished from typical *S. Bebbiana*. Some are very glabrous. I have not yet seen the Alaskan material mentioned by Coville. What I call var. *perrostrata* seems to be the form prevailing from western Nebraska and western South Dakota through Colorado, northern New Mexico, eastern Arizona, Utah, northeastern Nevada and northeastern Oregon; this form apparently is becoming more similar to or is connected with the typical form by many intermediate forms in Idaho, Washington, British Columbia, Alberta, eastern Alaska (Cook Inlet, according to Coville), the Yukon Territory and the western parts of the Northwestern Territories. The typical *S. Bebbiana* seems to be predominant from Fort Franklin in the Northwest Territories to the James Bay and to Newfoundland, its range extending to the south to New Jersey, Pennsylvania, northern Ohio, northern Indiana, northern Illinois and Iowa. Very often it is almost impossible to decide in the herbarium whether a specimen belongs to var. *perrostrata* or to the type. Only a thorough study of copious material collected in those regions where both forms meet can prove whether var. *perrostrata* is a variety of real taxonomic value. Fernald (1914) sees in it the common Rocky Mountain representative of the species, and says that the leaves are less rugose or almost plane and glabrate in age, and the branchlets glabrate or quickly glabrescent. Its synonymy is as follows:

1b. *S. Bebbiana*, var. *perrostrata*, comb. nov. — *S. Bebbiana* Rydberg in Contrib. U. S. Nat. Herb. III. 523 (1896), pro parte maxima, non Sargent. — Coville in Proc. Wash. Acad. Sci. III. 306, fig. 17 (1901), pro parte maxima. — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909) pro parte maxima. — *S. perrostrata* Rydberg in Bull. N.Y. Bot. Gard. II. 163 (1901); in Britton, Man. 317 (1901); Fl. Rocky Mts. 195 (1917). — Britton & Brown, Ill. Fl. ed. 2, I. 599 (1913). — *S. rostrata* var. *perrostrata* Fernald in *Rhodora*, XVI. 177 (1914). — A typo praecipue recedit foliis maturis etiam superioribus subtus fere vel omnino glabrescentibus laevioribus plerisque minoribus saepe tenuioribus, ramulis saepissime magis glabrescentibus.

In Colorado and New Mexico certain forms seem to occur of which the branchlets are somewhat pruinose. I enumerate the following specimens which need further observation.

COLORADO. Teller County: Colorado Springs, Pikes Peak, September 10, 1905, Glatfelter (st.: M.). El Paso County: Manitou, about 3300 m., September 9, 1905, same collector (fr. mat., st.; M.; fructibus adultis glabris sed normalibus¹); Ute Pass, above Manitou Springs, along Fountain Creek, September 1, 1881, G. Engelmann (st., M.; forma incerta satis pubescens).

NEW MEXICO. Santa Fé County: Santa Fé Canyon, 9 miles east of Santa Fé, May 14, 1897, A. A. & E. G. Heller. (No. 3524, f.; M.); Santa Fé Creek above

¹ A form with entirely glabrous ovaries and pedicels has been collected by Macoun, Cabin Creek, Jasper Park, Alberta (No. 95792, O).

Santa Fé, September 18, 1916, *A. Rehder* (Nos. 604, 609, st.; A.; "shrub 10 feet"); same place, September 4, 1894, *C. S. Sargent* (st., A.; "tree 20 × 1 ft., pendulous branches, rough trunk, deeply furrowed dark brown bark").

With regard to the eastern forms proposed by Fernald of which I have seen the types the following may be said. The first variety is var. *luxurians* (in *Rhodora*, ix. 223 [1907]) which "is clearly an extreme variation of the common *S. rostrata*." It chiefly differs from it by its longer capsules (9 to 12 mm. long) and longer pedicels (5 to 8.5 mm. long). So far it has been only seen "on banks of the St. Lawrence from Rimouski Co. to Gaspé Co." in Quebec. It should be looked for in other localities of the type, and it apparently is nothing but a forma *luxurians*.

Fernald's next variety, var. *capreifolia* (in *Rhodora*, xvi. 177 [1914]) "presents the most extreme development of pubescence in the species . . . while var. *perrostrata* shows the opposite tendency." According to the material before me var. *capreifolia* is closely connected with the type by frequent intermediate forms. Fernald thinks that it "may prove to be the same as *S. vagans* l. *rostrata* forma *latifolia* Andersson" of which I have already spoken. This is, however, in my opinion an uncertain form, and may even belong to another species. To var. *capreifolia* Fernald refers specimens from Newfoundland, eastern Quebec and Nova Scotia, and it apparently has a wider distribution.

Fernald states "in typical *S. rostrata* Richardson (*S. Bebbiana* Sargent) the new branchlets are pubescent at tip, but the pubescence is early deciduous." In the specimen of Richardson which I regard as the co-type (see p. 66) the branchlets of the season are distinctly pubescent, and only somewhat glabrescent toward the base, but even the branchlets of the preceding year are at least partly pubescent. Very rarely these branchlets are glabrous or almost so. The pubescence of the leaves, too, of typical *rostrata* is hardly very different from that of var. *capreifolia* of which the lower leaves also are partly glabrescent. A closer study of the western form may, however, lead to the hypothesis that there are glabrescent and pubescent forms of the type as well as of var. *perrostrata*.

The most striking of Fernald's forms is var. *projecta* (in *Rhodora*, xvi. 178 [1914]) which so far is very incompletely known. It has only been found in Newfoundland, Wild Cove, south of Bay of Islands, June 11, 1896, by A. C. Waghorne (fr.; G.). According to Fernald it differs from all varieties of *S. Bebbiana* "in the slender elongate ament, the long scales, the short capsules and pedicels shorter than the scales." Unfortunately there are neither mature leaves nor well-ripened capsules. The male plant, too, is unknown. Fernald says: "when better known this may prove to be a distinct species."

2. *S. Geyeriana* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 122 (1858), quoad specim. fem.; in Proc. Am. Acad. iv. 63 (Sal. Bor.-Am. 17) (1858); in Walpers, Ann. Bot. v. 750 (1858); in Svensk. Vet.-Akad. Handl. vi. 86 (Monog. Salic.) (1867), excl. t. 5, fig. 50; in De Candolle, Prodr. xvi.² 226 (1868). — Rydberg in Mem. N.Y. Bot. Gard. i. 114 (Cat. Fl.

Mont.) (1900); Fl. Colo. 95 (1906); Fl. Rocky Mts. 195 (1917). — Howell, Fl. N.W. Am. 619 (1902). — Piper in Contrib. U.S. Nat. Herb. xi. 215 (Fl. Wash.) (1906). — Ball apud Coulter & Nelson, New Man. Rocky Mts. Bot. 138 (1909); apud Piper & Beattie, Fl. N.W. Coast, 117 (1915); in Bot. Gaz. LX. 399 (1915). — Henry, Fl. S. Brit. Col. 98 (1915). — *S. macrocarpa* Nuttall, N. Am. Sylva, i. 67 (1843), pro parte, non Trautvetter. — Bebb in Bot. Gaz. x. 221 (1885). — Macoun, Cat. Can. Pl. ii. 360 (1890). — Ball in Trans. Acad. Sci. St. Louis, ix. 80 (1899).

This Willow was first described as *S. macrocarpa* by Nuttall from specimens collected in Oregon. He does not quote a locality but only says "forming clumps in wet places." According to a co-type in the Gray Herbarium Nuttall had before him a form of var. *meleina*, but in his description he states that "the branches are smooth and brownish black, sometimes glaucous or whitish." Nuttall's name cannot be used because it is preoccupied by Trautvetter.

As Bebb already explained in 1885 Andersson entirely mistook Nuttall's species. He "transferred Nuttall's name to a single specimen collected by Burke 'ad Hudson Bay,' which Nuttall never saw, and described a new species of his own, *S. Geyeriana*, which . . . coincides absolutely with *S. macrocarpa*, Nutt." Andersson's *macrocarpa* is a species with "capsulis breve pedicellatis, conicis, glaberrimis, stylo mediocri, stigmatibus integris; foliis exstipulatis lanceolatis, integris, subtus pallidioribus, utrinque glaberrimis." It is entirely different from Nuttall's Willow which the author regarded as closely related to the Pond Willow (*S. sericea*). Andersson (1858) apparently had no knowledge of Nuttall's description, but he had an opportunity to examine those of Nuttall's specimens which are preserved in the Hookerian Herbarium. When he described his *S. Geyeriana* he based it on Geyer's No. 286 of which the exact locality is unknown. Andersson says "Missouri and Oregon, Rocky mountains." I have seen a photograph of this number and fragments of the female specimen, and also a male ament. The female plant only is *S. Geyeriana*, while the male ament belongs to *S. Bebbiana*. This has already been elucidated by Bebb, and he is right in the statement that Andersson's description is almost wholly drawn from the female plant. The male specimen is only mentioned in the following sentence (1858): "Amenta mascula etiam breviora et crassiora stamina magis aureo-fulvis quam in *S. vaganti* [*S. Bebbiana*]." In 1868, too, Andersson says: "*S. vaganti-rostratae* valde similis" but to Bebb this comparison seems "unintelligible" because "the affinity of the plant in question — as Nuttall had the sagacity to see — is really with *S. sericea*." I do not quite agree with Bebb because the shape of the capsules is very different in both species. Of *S. sericea* the mature fruits are short and blunt scarcely longer than 5 mm. with a pedicel 1.5 (–1.7) mm. long, while in *S. Geyeriana* the ovoid-rostrate capsules measure almost (5–)6–7 mm. in length excluding the 2–3 mm. long pedicel. Their shape is much more like that of the fruits of *S. Bebbiana*.

According to the female plant of Geyer's No. 286 the typical *S. Geyer-*

iana is the form with pruinose branchlets of which those of the year bear a fine silky tomentum. The statement of Andersson that the pedicel is six times longer than the gland is not correct as it is only 2 to $2\frac{1}{2}$ times longer. The stigmas are not sessile but they show a short style which often is bifid at the top, but hardly longer than the two-cleft stigmas. The statement "foliis molliter tomentosis" seems to indicate that Andersson probably had before him other specimens of *S. Bebbiana* than the male of which I have seen a photograph. In 1867 he speaks of the male aments as "sessilia, ebracteata" while in 1868 he says "vix bracteata." The type of *S. Geyeriana* before me clearly shows a short but distinct peduncle with a few small leaflets at least under the upper aments. The leaf represented in fig. 50 on plate 5 of Andersson's monograph certainly belongs to *S. Bebbiana*, the drawing of the female flower, too, agrees much better with this species. The statement of Geyer that the plant is "10-15 feet high" also refers to *S. Bebbiana* a species which as a whole is so easily distinguishable from *S. Geyeriana*.

There are two forms which can be separated from the type. One has been described by Bebb as var. *argentea* (of *S. macrocarpa*) for the type of which has to be taken a specimen of Lemmon's from Sierra County, California, of which I have seen co-types in Herb. G. and M. In Bebb's Herbarium is a male specimen collected by Lemmon at Sierra Valley without date and number but I have found no real type. This var. *argentea* is probably nothing but a very silky form of the type and its synonymy is as follows:

2b. *S. Geyeriana* var. *argentea*, comb. nov. — *S. Geyeriana* Bebb apud Watson, Bot. Cal. II. 87 (1879), non Andersson. — Rydberg, Fl. Colo. 95 (1906), ex parte. — *S. macrocarpa*, var. *argentea* Bebb in Bot. Gaz. x. 223 (1885); apud Coville in Contrib. U.S. Nat. Herb. iv. 199 (1893). — Ball in Trans. Acad. Sci. St. Louis, ix. 80 (1899). — *S. leucosericea* Bebb & Nelson apud Nelson in Bull. Wyom. Exp. Stat. No. 28, 179 (First Rep. Fl. Wyom.) (1896), nom. nud.¹ — A typo praecipue recedit pubescentia ramulorum foliorumque novellorum densiore et omnino argentea vel tantum pilis paucissimis ferrugineis intermixta.

Of this variety I have seen specimens from the following states and counties: southern Idaho (Owyhee, Bear Lake and Blaine Counties), eastern Oregon (Union, Crook and Harney Counties), Wyoming (Fremont, Sweetwater, Albany, Sheridan and Bighorn Counties), Colorado (Laramie, Lake and San Miguel Counties), Nevada (Elko County), California (Plumas, Sierra, Nevada, Placer, Eldorado, Mono, Tuolumne, Tulare, and Fresno Counties).

Another form of apparently greater taxonomic value is var. *meleina* described by Henry (Fl. S. Brit. Col. 98 [1915]) as follows: "var. *meleina*:

¹ Nelson, l. c., says: "In communicating this name to me Mr. Bebb made the following comment: 'It will shortly appear as above in a government report. This is the Rocky Mountain or Plateau member group which has for its eastern or Atlantic Coast representatives, *S. sericea* and *S. petiolaris*, and for the Pacific Coast *S. macrocarpa*.'"

Taller, 1-7 m. high; twigs black or green and black, without bluish bloom, the older branches often banded with gray and black; leaves oblong, soon glabrous above, very glaucous beneath, the hairs on the lower surface becoming more or less brown. The coast form; Shawnigan; Victoria; New Westminster." As I already stated it is partly the typical *S. macrocarpa* of Nuttall. The leaves sometimes are somewhat denticulate, the lower surface often becomes almost glabrous and their texture is firmer than of those of the type. The branchlets of the year are not unfrequently rather orange-colored (see for example Suskendorf's specimens from Falcon Valley, September 7, 1896). Of var. *meleina* I have seen specimens from British Columbia (Vancouver Island and New Westminster District), Washington (Stevens, King, Mason, Thurston, Pierce, West Klickitat and probably Clarke Counties where Nuttall seems to have collected the type of *S. macrocarpa* on the banks of the Columbia), Montana (Flathead and Missoula Counties) and northwestern Oregon (Columbia and Marion Counties).

The typical *S. Geyeriana* is known to me from the following states and counties: northwestern Idaho (Shoshone and Latah Counties), Montana (Deer Lodge, Gallatin and Madison Counties), Oregon (Grant, Jackson, Crook, Wallowa, and Klamath Counties), Wyoming (Yellowstone Park, Albany and Sheridan Counties), eastern Nebraska (Scotts Bluff County), Colorado (Jackson, Larimer Lake, Gunnison, Mineral, and Grant Counties) and Utah (Sevier County; a specimen of H.D. Langille, from Uinta Mountains, 1902, [No. 125, m., f.; A.; "5-7 feet high"] is uncertain, the leaves show stomata in their upper epidermis), Arizona (Coconino and Apache Counties).

3. *S. Lemmonii* Bebb apud Watson, Bot. Cal. II. 88 (1879); in Bot. Gaz. XVI. 106 (1891) — Jepson, Fl. Cal. 343 (1909), pro parte. — Rydberg, Fl. Rocky Mts. 196 (1917), pro parte. — When Bebb described this species he proposed three varieties basing his descriptions mainly on specimens collected by J. G. Lemmon in Sierra County, California. The first is var. *melanolepis* characterized by pitch-black and slightly or not at all hairy scales. Bebb cites no type but there is one in his herbarium in the Field Museum (No. 7794) consisting of male and female specimens. Here, too, are type specimens of the second var. *macrostachya*, and the third var. *sphaerostachya*, and two sheets which represent the typical form. All these specimens came from Sierra Valley in Sierra County, except those of var. *sphaerostachya* which are only marked "Sierra Nevada."

The type of *S. Lemmonii* (No. 7800 in Herb. Bebb) has unripe fruits and young leaves, and well agrees with that of var. *melanolepis*. The differences mentioned above are of no importance, because we can observe a change in the pubescence of the bracts not only in the aments of the same twig but even in the bracts of the same ament. Only in the male syntype of var. *melanolepis* (sheet 7799 in C.) the glabrousness of the bracts is a little more conspicuous. The size of the aments and the more or less ful-

vous pubescence of the young leaves are the same in both types. The young twigs are thin, slender, mostly covered with a grayish and rusty pubescence but soon becoming glabrous.

Bebb's var. *macrostachya* has female aments which measure up to 6.5 cm. in length but their peduncles are hardly different (Bebb says "more leafy"). The style is 1 mm. long; the fruits are not yet quite mature and scarcely more "tapering to a produced style" than those of the other forms. The male aments are hardly a little larger (to 3.5 : 1.3 cm.), and scarcely more silky than those of the type. In his main description Bebb says: "scales . . . black, thinly pilose." The pedicels always are only 2 to 3 times and not "4-6" times longer than the nectary. The var. *sphaerostachya* certainly is nothing but "a depauperate or subalpine form" as Bebb himself indicated. The type in Bebb's herbarium bears the No. 6752, and it is identical with a cotype in the Gray herbarium. The reddish brown or orange-colored branchlets show faint traces of a glaucous bloom thus pointing to var. *Austinae* (see later).

Bebb likened his species to *S. macrocarpa* (= *S. Geyeriana*) which "differs especially in its smaller pale acute scales, glabrate capsules, and nearly sessile stigmas." *S. Geyeriana meleina* has a rather distinct style (up to 0.5 mm. long), and there seems to be no difference as to the pubescence of the capsules. In this form of *S. Geyeriana* the glaucous bloom of the twigs is also wanting.

The leaves of *S. Lemmonii* are not only "paler or scarcely glaucous beneath" (Bebb) but the mature ones are distinctly glaucescent and by no means "green, nearly alike on both sides," as Jepson says. See Lemmon's specimen with mature leaves which Bebb makes the type in his herbarium (No. 6753 Bebb). *S. Lemmonii* apparently has been misunderstood by recent authors, and the diagnosis of Bebb is rather insufficient. Therefore I think it best to give the following more complete description and an enumeration of the specimens which I have seen. Frutex erectus ut videtur divaricato-ramosus, 1-3, raro ad 5 m. altus. Ramuli novelli tenuiter sericeo-pilosiusculi (pilis argenteis ferrugineisque mixtis), hornotini glabri vel fere glabri, interdum parce pruinosi (confer specimina a cl. Ware in Mono Pass lecta), annotini biennesque brunnescentes, purpurascences (vel interdum fere atropurpurei), glabri, nitiduli (in *S. Geyeriana* opaci), demum cinereo-nigrescentes; gemmae ut videtur ovoideo-oblongae vel ovoideae, obtusiusculae, ut ramuli coloratae, demum glabrae, divaricatae, floriferae quam foliiferae crassiores. Folia membranacea, sed adulta satis firma, anguste lanceolata, oblanceolata, anguste elliptico-lanceolata, basi acuta vel subobtusa, apice acuta ad subacuminata, interdum subapiculata, infima pleraque obtusiora, margine integra vel (saltem ad medium) parce distanter brevi-denticulata, infima saepe oblongo-spathulata interdum densius obscure glanduloso-denticulata, 1 : 0.3 ad 2.5 : 0.6 cm., superiora perfecte evoluta 3 : 0.8 ad 5.5 : 1 vel 7-9 : 1-1.5-1.8 cm. magna; superne novella plus minusve adpresse sericea vel sericeo-villosula, pilis griseis et ferrugineis mixtis, deinde saepissime cito glabrescentia et adulta glabra

vel pilis paucis difficile recognoscendis praedita, ut videtur vivide et intense viridia, in epidermide stomatibus plus minusve numerosis instructa, laevia vel costa nervisque laevissime prominulis; subtus initio ut superne pilosa, demum etiam, saepe citius, glabrescentia et adulta distincte glaucescentia, pleraque tenuissime adpresse breviter sericea glabrave, costa flavescente elevata, nervis lateralibus utrinque 6-10 (-12) vix prominulis; petioli tenues, pilosuli (saltem superne in sulco), 2-7 mm. vel interdum fere ad 16 mm. longi; stipulae minimae vel parvae, lanceolatae vel semi-ovato-lanceolatae, plusminusve acutae, glanduloso-denticulatae (partim lobulato-dentatae), ut folia pilosae, petiolis pleraeque 2-3-plo breviores, deciduae vel nullae, raro in surculis ad 8 mm. longae. Amenta coetanea, pedunculo brevi bracteato vel distincte foliolato suffulta, rhachi villosula; mascula densiflora, ellipsoideo-cylindrica vel cylindrica, 1:0.7 ad 3:1.2 (rare ad 3.5:1.4) cm. magna pedunculo brevissimo vel vix ultra 5 mm. longo foliolis lanceolatis acutis plus minusve integris superne fere glabris subtus adpresse et satis longe sericeis (pilis ferrugineis argenteisque mixtis) vix ultra 12:4 mm. magnis praedito excluso; bractee obovatae vel obovato-oblongae, apice rotundatae vel obtusiusculae, laxae longe sericeae, pilis summis quam bractea saepissime subbrevioribus, rarius apice plusminusve glabrescentes; stamina 2, filamentis liberis (interdum paullo vel ad $\frac{1}{3}$ coalitis), fere ad medium pilosis bracteam demum 2-3-plo superantibus, antheris aureis parvis crasse ellipsoideis; glandula 1, ovoideo-rectangularis, truncata, bractea duplo vel subduplo brevior; amenta feminea sub anthesi 1-2.5:0.8-1 cm. magna, pedunculo ut in masculis vel ad 6-12 mm. longo et distinctius foliolato (foliolis saepe deciduis), fructifera 2:1.5 ad 3.5-4:1.8 (rarius ad 6:2) cm. magna; bractee ut in masculis vel interdum apice acutiusculae, initio pedicellum paullo vel interdum fere subduplo superantes, demum eum aequantes vel rarius eo $\frac{1}{4}$ breviores; ovaria anguste ellipsoideo-conica, breviter sericeo-tomentosa vel laxius plusminusve adpresse sericeo-villosula; styli breves, saepissime 0.5-1 mm. longi, integri vel apice breviter bifidi; stigmata breviter oblonga, bifida, stylo circiter duplo, rarius paullo tantum breviora; pedicelli distincti, tenues, 1.5-2 vel in fructibus interdum ad 2.5 mm. longi, ut ovaria pilosi vel (in typo) partim vel fere omnino glabri; glandula 1, ventralis, ut in masculis vel paullo angustior, in ovariis pedicello 2-2 $\frac{1}{2}$ -plo, in fructibus interdum ad 3-plo (sed non 4-6-plo ut ab auctore indicatum) brevior. Fructus perfecte maturi ellipsoideo-vel ovoideo-rostrati, pedicello excluso 6-8 mm. longi, ut ovaria vel paullo laxius pilosi.

SPECIMENS EXAMINED: CALIFORNIA. Lassen County: Hot Springs Valley, near Lassen Peak, circ. 2000 m., June 6, 1910, *W. L. Jepson* (No. 4081, fr.; Jeps.; a small-leaved form resembling var. *meleina*). Plumas County: without exact locality, May 1877, *R. M. Austin* (f.; G.; the male specimen is *S. lasiolepis*); June 1878, same coll. (m., f.; G.); May 1879, same coll. (f.; G.; forma incerta ovariis partim pedicellis totis glabris, foliis superne parce stomatiferis); Warner Valley, about 1700 m., June 5, 1910, *W. L. Jepson* (No. 4066, st.; Jeps.; forma porro observanda foliis parvis superne sparse stomatiferis); Portola, May 25, 1918, *A. Eastwood* (No. 7004, f., 7005, m.; A.). Sierra County: Sierra Valley, without date, *J. G. Lem-*

mon (st., old fruits; sheet 6753 in C.), same coll. (f., type of var. *melanolepis*, sheet 7794 in C.; m., sheet 7799); same coll. (fr. juv., type of *S. Lemmonii*, sheet 7800 in C.); same coll. (f.; type of var. *macrostachya*, sheet 6754 in C.; m.; sheet 7795); same coll. (f., fr.; sheets 7798, 7796 in C.); Sierra Nevada, same coll. (f. m.; type of var. *sphaerostachya*; sheet 6752 in C.); west side of Webber Lake, near shore, June 21, 1900, *W. R. Dudley* (No. 5415, m.; St.); shore of Webber Lake, the common Willow, August 29, 1894, *Dudley* (st.; St.). Nevada County: Ice Lake near Soda Springs, on Pacif. Railr., about 2800 m., October 11, 1880, *G. Engelmann* (st.; M.); Truckee, May 1892, *C. F. Sonne* (No. 40, f.; C.); flat land on Yuba River, opposite Cascade, June 15, 1900, *W. R. Dudley* (No. 5151, a. m.; St.); valley near Lake Mary, near Summit, same date and coll. (Nos. 5104, m., 5111, f., 5115, m., 5115^a, f., 5116, f., 5116^a, m., 5117, f., 5120, m., 5122, f., 5128, fr.; St.); along South Yuba River, same date and coll. (Nos. 5139, fr., 5139^a, m.; St.); near hotel at Summit, same date and coll. (Nos. 5103, m., 5130, fr.; St.); grade east of hotel at Summit, same date and coll. (Nos. 5092, 5098, f.; St.); road between Summit and Cisco, same date and coll. (Nos. 5141, f., 5142, fr., 5143, fr., 5144, m., fr., 5145, f., 5146, m.; St.); Donner Lake, 500 yards below upper dam, June 14, 1900, same coll. (No. 5019, fr.; St.); Webber Lake and Serraville Trail, June 21, 1900, same coll. (No. 5475, f.; St.) Glenbrook near Truckee, June 28, 1900, same coll. (Nos. 5775 m., 5777, 5778, 5780, fr.; St.); Tahoe City, on meadow, most common willow, June 29, 1900, same coll. (Nos. 5796, 5799, 5800, fr.; St.); Independence Lake, meadow east of outlet and below bridge, June 19, 1900, same coll. (No. 5278, m.; St.). Placer County: Summit, about 2700 m., July 16, 1909, *A. A. Heller* (No. 9842, f.; G; sub nomine *curtiflora* distributa); low grassy places along Yuba River below Cisco, about 1800 m., June 17, 1917, same coll. (Nos. 12688, 12721, f.; St., C.); Lake Tahoe Region, Deer Park, June 15-19, 1912, *A. Eastwood* (Nos. 364, m., 432, f.; A.); road above Donner Lake, June 14, 1900, *W. R. Dudley* (No. 5081^a, f.; St.); between Donner Lake and Summit on "loop grade," same date and coll. (Nos. 5065, 5065^a, fr., 5066, 5067, f., 5069, m., 5070^a, f., 5077, 5078, fr.; St.); by Lake shore near Maddenie Cr. above McKinney's Cr., June 1900, same coll. (No. 5533, st.; St.). Eldorado County: Tallac (?) House to Desolation Valley, June 1900, same coll. (fr.; St.); near Tallac (?) House, June 28, 1900, same coll. (No. 5666, fr.; St.); near Camp Agassiz, June 17, 1900, same coll. (No. 5665, fr.; St.); Glenn Alpine, June 1900, same coll. (No. 5661, fr.; St.). Alpine County: near Highland Lake, about 2700 m., July 24, 1911, *L. R. Abrams* (Nos. 4748, f., m.; 4751, f.; G., St.); Icebery (?) Meadow, Clock's fork, about 2200 m., July 22, 1911, same coll. (No. 4745, fr.; St.). Amador County: Silver Lake, about 2700 m., July 1892, *G. Hansen* (No. 199, fr.; M., St.). Mariposa County: Yosemite Valley, May and June 1900, *F. T. Bioletti* (f., m.; A.); vicinity of Lake Tenaya, about 2700 m., June 1902, *Hall & Babcock* (No. 3524, m., fr.; Jeps., St.); Lake Merced, about 2400 m., July 9, 1909, *W. L. Jepson* (No. 3194, fr.; Jeps.); Glacier Point, Turn Pike, May 26, 1888, *J. W. Congdon* (No. 123, f.; St.). Mono County: Mono Pass, Bloody Canyon, about 2800 m., July 23, 1907, *R. A. Ware* (fr.; G.; folia maxima ad 6.5:1.1 cm. magna, ramuli partim parce pruinosi). Tuolumne County: Tuolumne River Meadow, 2 mi. below Soda Springs, about 2750 m., July 18, 1909, *W. L. Jepson* (No. 3357, st.; Jeps.); Kennedy's Lake, about 2700 m., August 12, 1915, *A. L. Grant* (No. 246, fr.; A.). Fresno County: Horse Corral Meadow, region of King's River, August 11, 1900, *W. R. Dudley* (Nos. 3174, fr., 3177, st.; St.); King's River Canyon, same date and coll. (No. 3214, fr.; St.); Upper King's River, Rowell Meadow woods, June 21, 1900, same coll. (fr.; St.). Tulare County: Sequoia National Park, Marble Fork, about 2500 m., July 15, 1902, *G. B. Grant* (No. 1514, fr.; St.); [Milky Meadow to Three Rivers], Whitney (now Volcano) Creek, about 2800 m., July 23-31, 1900, *W. L. Jepson* (No. 954, st.; Jeps.); region of Sequoia National Forest, Vicinity of Homer's Nose, Cahoon Meadow, about 3000 m., July 13, 1897, *W. R. Dudley* (No. 1846, fr.; St.); region of Little Kern River, Barut (?) Corral Meadow, August 10, 1897, same coll. (No.

1979, fr.; St.); Vicinity of Mount Whitney, August 8, 1897, same coll. (No. 2501, st.; St.)

NEVADA. Ormsby County: Snow Valley, 2460-2615 m., June 24, 1902, *C. F. Baker* (No. 1162, f., m.; A., Cal., G., N.). Washoe County: Divide, south of Slide Mountain, in granite, about 2500 m., *A. A. Heller* (No. 10928, fr.; A., C., G., M.); ridge above Bowers, about 2200 m., same date and coll. (No. 10937, fr.; St.); about Marlette Lake, 2460 m., July 10, 1902, *C. F. Baker* (No. 1294, fr.; Cal.).

According to Jepson *S. Lemmonii* is also known from the Wasatch Mountains in Utah, but I have not seen any material from that region. Rydberg states that the species occurs as far east as Idaho. What I have seen from Idaho bearing the name *S. Lemmonii* did not at all belong to this species. This is the case, too, with Cusick's No. 1835 from eastern Oregon which (at least partly) seems to consist of male and female specimens of different species. His No. 1836 mostly represents the following variety.

S. Lemmonii, var. *Austinae*, var. nov. — *S. Austinae* Bebb apud Watson, Bot. Cal. II. 88 (1879); in Bot. Gaz. XVI. 106 (1891). — Bebb described *S. Austinae* from specimens collected by Mrs. R. M. Austin at Indian Valley, Plumas County, California. In Bebb's herbarium I have found only one specimen by this collector under *S. Austinae* (sheet 3388). Bebb did not put a name on it but he made sketches of the male and female flowers on the sheet. It is identical with other sheets in Herb. C. (Herb. Patterson) and in Herb. C. U. In 1891 Bebb stated that "the leaves described belong to *S. Lemmonii*, and in some (though not all) of the specimens male aments of *S. lasiolepis* were intermixed." But "there yet remain the fertile aments not identifiable with any willow of the Pacific Coast region as at present understood." If we take sheet 3388 in C. which well fits Bebb's description for the type it can be said that the leaves are not distinguishable from those of *S. Lemmonii*. The male and female aments, however, may well belong to one species, and the male aments are not identical with those of *S. lasiolepis*. Bebb does not describe the male flowers, but his sketch on the sheet shows glabrous filaments. A close investigation of the flowers revealed to me the fact that the filaments are hairy for about a fifth of their length and are often slightly connected at the base. The flowering branchlets are glabrous, orange-colored, and slightly shining. Those of the male specimen are hardly pruinose while the glaucous bloom is rather conspicuous on the branchlets of the female specimen which are of the same color. This glaucous bloom seems to be the main character to distinguish var. *Austinae* from *S. Lemmonii*. It is also to be seen on the specimens collected by Cusick in eastern Oregon (No. 1306 and 1836) which are named *S. Lemmonii*, and on a piece without number in Bebb's herbarium (sheet 7760 in C.). Pruinosity I also observed in Grant's No. 290 from Tuolumne County, the leaves of this specimen having stomata in their upper epidermis. After all I suppose that *S. Austinae* can best be considered a variety of *S. Lemmonii* but certainly a thorough study of more copious material is needed than I have been able to investigate. From the specimens enumerated below I have drawn the following diagnosis. Frutex vel arbor parva;

ramuli initio laxe tenuiter pilosuli pilis griseis et paucis fulvis mixtis, hornotini autumnio glabri, flavo-brunnei vel ut annotini floriferi magis rubescentes vel purpurascens, nitiduli, saepe leviter pruinosi; gemmae (in No. 1836 Cusickii) ovoideo-oblongae, acutae, petiolis plusminusve aequilongae. Folia textura coloreque ut in *S. Lemmonii*, initio fusco-pilosi pilis griseis intermixtis (in costa etc.), pubescentia, deinde quamvis ut in *S. Scouleriana*, anguste lanceolata vel lanceolata, basi acuta vel saepissime satis obtusa, apice acuta vel breviter acuminata (minimis lineari-oblongeolatis obtusioribus exclusis), 3.5:0.8 ad 6.5:1.1 vel ad 9:2 vel 8:2.1 cm. magna, margine obscure subserrata vel satis distanter serrata, superne subtusque ut in *Lemmonii*, subtus distincte albescentia vel glaucescentia, pruinosa, costa elevata flava nervisque lateralibus flavis graciliter prominulis et satis indistincte reticulata; petioli stipulaeque ut in *Lemmonii*. Amenta praecocia vel subcoetanea, cylindrica, densiflora, pedicello brevi foliola minima 2-3 lineari-lanceolata superne glabra subtus sericea decidua gerente 1-5 mm. longo suffulta; mascula vix ultra 2.8:1.2 cm. magna; bractae atrofuscae, obovato-oblongae, utrinque sericeae, obtusae; stamina 2, filamentis basi parce pilosis, interdum paullo coalitis, bracteam duplo superantibus, antheris ellipsoideis flavis; glandula 1, oblongo-rectangularis, truncata, bractea subtriplo brevior; amenta feminea sub anthesi 2-2.8:1 cm. magna; bractae ut in floribus masculis; flores ut in *Lemmonii*; styli vix ultra 0.5 mm. longi; pedicelli vix ultra duplo longiores quam glandula; stigmata stylo subaequilonga, breviter oblonga, divaricata; glandula ut in masculis. Fructus maturi mihi tantum ignoti.

SPECIMENS EXAMINED: CALIFORNIA. Plumas County: Indian Valley, without date, *Mrs. Austin* (m., f., st.; type in C., sheet No. 3388; the same is sheet 361195 in C. U., 204066 Herb. Patterson in C. and sheet 346815 Herb. Schuette in C.; on sheet 204065 Herb. Patterson in C. is a label of Bebb's with the note: "I suppose we call this all *S. Austinae* — but I begin to fear that the dividing line between *Austinae* and *Lemmonii* is hazy to say the least"). Sierra County: Sierra Valley, without date, *Lemmon* (m., f.; sheet 7792 Herb. Bebb in C.; apparently nothing but typical *Lemmonii*; the same is sheet 7793).

OREGON. Union County: without date, *Cusick* (m., f.; sheet 7760 in C.; named by Bebb "*S. Lemmonii*, mixed with flowers of *S. flavesces*." The male branchlets are distinctly pruinose; the sterile specimen has lanceolate obovate acute leaves with a more or less conspicuous crenate dentation, a glabrous under surface, and distinct stipules). County?: Mountains of Eastern Oregon; banks of streams, about 1350 m., *Cusick* (No. 1306, fr., st.; sheet 7759 in C.; leaves and branchlets as in the foregoing specimen); a slender shrub of streambanks, April 19, May 9, September, 1898, same coll. (No. 1836, f.; sheet 109712 in C.; named *S. Lemmonii* but looking much like *S. Geyeriana*, leaves without stomata in their upper surface); apparently same region, same date and coll. (No. 1835, f., m. st.; sheet 109711 in C.; the large leaves partly become greenish beneath, the bloom of the twigs is hardly recognizable; in different herbaria are somewhat different specimens under this number.)

Bebb (1891) said, that Cusick found the species in eastern Oregon but unfortunately he did not quote Cusick's numbers. In Bebb's herbarium I have found the three sheets of Cusick's just mentioned. To the sheet 7759 are added two letters of Cusick's, in one of them (dated October 10, 1887) he states that his numbers 1510 and 1610 represent *S. Lemmonii*. I did

not, however, detect specimens bearing these numbers in Bebb's herbarium. Cusick also says in the letter the following as to the differences between *macrocarpa* (Geyeriana) and *Lemmonii*: "*S. Lemmonii* is a much larger shrub, sometimes a tree 8 or 10 inches in diameter; seldom or never upright, divaricately branching; growing in widely spreading clumps and commonly on the bank of rocky swift running streamlets. The *macrocarpa* form is smaller, slender and virgate; the tops gradually dissolving into small branchlets, one plant one inch in diameter is large and will be 6 to 8 feet high; it is found more commonly along sluggish or marshy streams. I saw it in great abundance on Stein's Mountains in Malheur Co. in the summer of '86." Possibly Cusick's *Lemmonii* is identical with var. *Austinae*. Another sheet of Cusick's (No. 7758) I take for *S. Scouleriana*. It consists of a sterile specimen with old leaves measuring up to 9-11 : 4-3 cm. and bearing beneath the typical short brownish pubescence of *Scouleriana*.

b. THE SPECIES OF SECTION ROSEAE

This section was proposed by Andersson in 1867 for the species *S. proluxa* Andersson, *S. myrtilloides* Linnaeus and *S. fuscescens* Andersson to which he added a number of European hybrids. The type species is *S. myrtilloides* because he named the section "Stirps X. Salices roseae v. *S. myrtilloides*," and later, in 1868, "§ 10. Roseae s. *Myrtilloides*." Andersson's first species *S. proluxa* is a very little known Willow. The true *S. myrtilloides* is not found in the New World where it is represented by *S. pedicellaris* Pursh treated by Andersson as a subspecies or as a variety of *S. myrtilloides*. *S. fuscescens*, too, needs further study, and this section as a whole is a group of rather doubtful taxonomic value. The best I can do at present is to discuss briefly these American species, and to advise other students who have a good opportunity to collect better material and to study the plants in the field. The synonymy of the group is as follows:

Sect. *Roseae* (sive *Myrtilloides*) Andersson in Svensk. Vet.-Akad. Handl. vi. 94 (Monog. Salic.) (1867); in De Candolle, Prodr. xvi.² 229 (1868). — Sect. *Arbusculae* Barratt apud Hooker, Fl. Bor.-Am. ii. 150 (1839), pro parte, quoad *S. pedicellaris*. — Sect. *Virentes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858), pro parte quoad *S. myrtilloides*. — Sect. *Myrtilloides* Zabel apud Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 30 (1903). — Sect. *Argenteae*, subsect. *Myrtilloides* Schneider, Ill. Handb. Laubh. i. 63 (1904).

1. *S. pedicellaris* Pursh, Fl. Am. Sept. ii. 611 (1814). — Poiret in Lamarck, Encycl. Suppl. vi. 62 (1817). — Torrey, Fl. N.Y. ii. 213, t. 120 (1843). — Hooker, Fl. Bor.-Am. ii. 150 (1839), quoad descr. sed probabiliter exclud. specim. — Carey apud Gray, Man. 429 (1848). — Britton & Brown, Ill. Fl. ed. 2, i. 602 fig. 1479 (913). — Griggs in Proc. Ohio Acad. Sci. iv. 313, t. 16 (1905) ex parte. — Robinson & Fernald, Gray, Man. ed. 7, 324, fig. 655 (1908). — Fernald in Rhodora, xi. 157 (1909). — *S. myrtilloides* Tuckerman in Am. Jour. Sci. xlv. 34 (1843), non Linnaeus. — An-

dersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 125 (1858). — Gray, Man. ed. 5, 465 (1867). — Bebb apud Gray, Man. ed. 6, 485 (1889). — Britton Man. 316 (1901). — Britton & Brown, Ill. Fl. i. 505, fig. 1204 (1896). — Piper in Contrib. U.S. Nat. Herb. vi. 214 (1906). — Ball in Proc. Iowa Acad. Sci. vii. 153, t. 12, fig. 14 (1900). — *S. myrtilloides* [subspec.] *S. pedicellaris* Andersson in Svensk. Vet.-Akad. Handl. 96 (1867). — *S. myrtilloides* var. β *pedicellaris* Andersson in De Candolle, Prodr. xvi.² 230 (1868).

The history, geographical distribution and variability of this "attractive bog willow" was fully given by Fernald in 1909. I do not wish to repeat what this excellent observer has said, and only the following statements from my own observations may be added. The shape of the leaves of the European *S. myrtilloides* is not always different from that of the American species. I have repeatedly observed in American specimens (see for instance Sandberg's No. 521) round-ovate or ovate-oblong leaves which are broadest near the base and rounded or subcordate at base but as a whole the differences indicated by Fernald hold true. I do not, however, agree with his interpretation of the type. Pursh indeed says: "foliis . . . utrinque concoloribus" but his plant was collected in April, and he apparently had not seen mature leaves. I have seen all the specimens referred to the type by Fernald but all of them have leaves with at least a partly more or less glaucescent undersurface. I am not convinced that the plant of Pursh of which no type specimen is in existence has to be regarded as different from the widely distributed form which Fernald has named var. *hypoglauca* (in *Rhodora*, xi. 161 [1909]). Pursh's plant came from the Catskill Mountains in New York, a region from which I have not seen any material of *S. pedicellaris*.

Fernald's var. *tenuescens* (l. c. 162) seems to me hardly more than a form with narrower leaves. There are some specimens from Illinois (Palmer, No. 15561, in A.) and from Indiana (Deam, No. 20118^a, in A) which need further observation.

2. *S. proluxa* Andersson in Svensk. Vet.-Akad. Handl. vi. 94 (1867); in De Candolle, Prodr. xvi.² 229 (1868). — Macoun, Cat. Can. Pl. i. 452 (1886). — Ball apud Piper & Beattie, Fl. N. W. Coast, 115 (1915). — Of this "forma elegantissima habitu omnino singulari" I have seen a photograph and fragments of the type which was collected by Lyall "ad Lower Frazer-River, 49 l.b." in 1859. Unfortunately I have misplaced part of my notes and sketches on it. According to Ball (1915) it chiefly differs from *S. pedicellaris* by longer pedicels, and thinner leaves with a coarser reticulation. It is said by Macoun (1886) to be "not uncommon around Victoria, Vancouver Island, also in the Valley of Thompson River, at Spence's Bridge, B.C." I asked Professor J. K. Henry, the well-known author of the Flora of Southern British Columbia for his opinion on this species, and he wrote to me in a letter of September 7, 1919, as follows: "As to *Salix proluxa* Andersson: I have never seen an authentic or typical specimen of this

plant. The Victoria collectors cannot find it. My own feeling was that it is not distinct from the very common *S. Mackenziana* the leaves of which are sometimes green beneath when the fruit is mature. Willow leaves, on this coast at least, mature very slowly and it is often midsummer before they assume the final shape and character. It does not seem to me that the analysis of Piper & Beattie in their Flora of the North West Coast is very satisfying as far as these two species are concerned. *Salix Mackenziana* about Victoria, B.C., is often a low shrub, while the scales are not black even when dry. The stipules, too, vary. Possibly, however, the specimens I enclose from New Westminster (from a shrub . . . on the moist bank of the Frazer River) you may consider *S. proluxa*."

I am not able to give a final judgment on these specimens. The type of *S. proluxa* is not sufficient to decide the question whether it is a good species or not. It does not possess well-matured fruits and leaves. Henry may be right that the plant which is considered to be *S. proluxa* by Ball does not represent a distinct species. On the other hand, *S. proluxa* may belong to those good species which have a very limited distribution, and are still in need of a better understanding. Not being well enough acquainted with some western forms of the *Cordatae* group I leave it to Ball and other salicologists to demonstrate the true taxonomic value of Andersson's species.

3. *S. fuscescens* Andersson in Svensk. Vet.-Akad. Handl. vi. 97 (1867); in De Candolle, Prodr. xvi.² 230 (1868), excl. var. — Coville in Proc. Wash. Acad. Sci. iii. 329, fig. 25 (1901). — *S. myrtilloides* f. 1 et 2 Chamisso in Linnaea, vi. 539 (1831). — *S. rhamnifolia* Hooker & Arnott, Bot. Voy. Beechey, 117, t. 26 (1832), excl. citat., non Pallas. — *S. phlebophylla* Rydberg in Bull. N.Y. Bot. Gard. i. 274 (1895), ex parte, quoad pl. Cape Blossom, non Andersson. — This species has been founded upon Hooker's *S. rhamnifolia* from "Awatschka Bay, in lat. 53°," Kamtschatka, the type of which was collected by Beechey & Mertens and is still unknown to me. In 1858, Andersson mentioned *S. rhamnifolia* Hooker but then he evidently was not quite sure whether this was identical with the plant Pallas and Ledebour took for this species. He also cited Chamisso's *S. myrsinites* (in Linnaea vi. 540) "ad sinum S:cti Laurentii" of which I have not seen the type, and also Chamisso's forms 1 and 2 of *S. myrtilloides* which, too, I have had no opportunity to compare. No. 1 came "e sinu Eschscholtzii" in Alaska, while No. 2 was collected "in paludibus prope Tigil Kamtschatscae occidentalis." In 1867 Andersson proposed the name *S. fuscescens* for what Hooker has called and figured as *S. rhamnifolia*. Andersson's fig. 54 quoted by him in 1868 is not given in his monograph.

Judging by the description and figure given by Hooker and by Andersson's own diagnosis I believe that the specimens regarded by Coville and myself as *S. fuscescens* really represent this species. I have not seen it from America except from Alaska and not eastward of the 150°. The following specimens which I have seen are not mentioned by Coville.

ALASKA. Kuskokwim Valley, 1884, *Weinmann* (f., fr.; G.); between Tyonok, on Cook Inlet, and Rampart City, Yukon River, Camp 7, Beluga Valley, about 330 m., June 10, 1902, *A. H. Brooks & L. M. Prindle* (fr. im.; W.); Yukon Delta, July 14, 1889, *J. C. Russell* (fr.; W.); St. Lawrence Island, July 13, 1899, *B. E. Fernow* (f.; Cor.); Lake Iliamna Region, Iliamna Bay, in sphagnum marsh, June 22, 1902, *M. W. Gorman* (No. 41, fr.; W.; "prostrate and creeping"); Valley of Kobuk River, at Kobuk portage between Alatna and Walker Lake, July 3, 1901, *W. C. Mendenhall* (fr.; W.; "small and creeping, from 3 to 10 in. high. Common in low places"); Seward Peninsula, Nome, 1914, *G. A. Hill* (No. 84, f.; W.); tundra behind Nome, "on moss hummocks plentiful," June 17, 1903, *F. L. Hess* (f., m.; St.; "in spreading communities"); Vicinity of Port Clarence, near entrance to lagoon, below mouth of Kuzitvin River August 2, 1901, *F. A. Walpole* (No. 1674, fr.; W.); Port Clarence, July 12, 1899, *B. E. Fernow* (f.; Cor.); Norton Sound, St. Michael, July 10, 1889, *J. C. Russell* (f.; W.); Cape Blossom, 1884, ? *S. B. McLenyan & St. Corvin* (fr.; G.; Rydberg 1899 as *S. phlebophylla*).

NORTHEASTERN ASIA. Arakam (Tchetchene) Island, 1853/6, *C. Wright* (fr.; G.; mixed with an *arctica* form).

In 1907 Fernald stated that *S. fuscescens* "hitherto known only from northern and western Alaska and the adjacent coast of Siberia, is abundant in bogs on the serpentine tableland of Mt. Albert" on the Gaspé Peninsula. According to my own observations the eastern specimens all belong to var. *hebecarpa* described by Fernald, and it may even be that this variety can be raised to the rank of a species. It chiefly differs from typical *S. fuscescens* by foliis saepissime apice paullo acutiusculis vel distincte acutis, capsulis pedicello brevi ut videtur fere semper piloso vix ultra 1.5 mm. longo excluso vix ultra 6-7 mm. longis brevius rostratis basi crassioribus, saepissime plusminusve vel omnino (praesertim basi) pilosis et distinctius glaucescentibus. What Fernald regards as typical *fuscescens* is in my opinion, only a glabrescent form of var. *hebecarpa* of which the pedicels never become wholly glabrous, and are always comparatively shorter and thicker than those of true *fuscescens*.

There is a female specimen collected by Trelease & Saunders under No. 3443 mixed with *S. ovalifolia* which Coville refers to *S. fuscescens*. It has, indeed, flowers very similar to those of this species but the ovaries are hairy and borne on shorter and thicker pedicels. It looks to me like a hybrid, and I do not think that it is a hairy form of *S. fuscescens* identical with the eastern var. *hebecarpa*.

There remain to discuss several species which I at present am unable to refer to one of the sections with which I have dealt.

The first is

S. arbusculoides Andersson in Svensk. Vet.-Akad. Handl. vi. 147 t. 8. fig. 81 (1867), excl. var. *glabra*. — Bebb in Bot. Gaz. xv. 54 (1890). — Macoun, Cat. Can. Pl. II. 358 (1890). — Coville in Proc. Wash. Ac. Sci. III. 323, fig. 21 (1901). — Rydberg, Fl. Rocky Mts. 196 (1917). — *S. arbuscula* Andersson in Öfv. Svensk. Vet.-Acad. Förh. xv. 130 (1858), excl. var. *labradorica*, non Linnaeus. — *S. humillima* Andersson in De Candolle, Prodr. XVI.² 248 (1868), excl. var. *glabra*. — Macoun, Cat. Can. Pl. I. 449 (1886). —

This Willow was first mentioned by Hooker (1839) as *S. acutifolia* Willdenow. Hooker gave a short description from specimens collected by Drummond and Richardson "Saskatchewan to Fort Franklin on the Mackenzie River," and said: "Mr. Borrer considers this to be the same as true *acutifolia* of Willdenow, from the Caspian Sea." This was, of course, a mistake, and our Willow has nothing whatever in common with Willdenow's well-known species. Hooker himself apparently regarded Borrer's determination as doubtful because he expressly stated that the twigs are not pruinose in the dried specimens. In the Herbarium of the New York Botanical Garden I have found a specimen of Richardson's from the Mackenzie River under "No. 65 Hb. H.B. & T.," and another specimen labeled "*Salix acutifolia* Fl. Bor. Am." of which the later indeed represents the typical *S. arbusculoides*. In 1858, Andersson mentioned *S. acutifolia* Willdenow saying nothing but "Ramum foliatum tantum in herb. vidi." He never quoted Hooker's plant. According to Bebb he passed the specimens of Drummond and Richardson in the Hookerian herbarium as *S. petiolaris*. He referred, in 1858, the plants on which he later based his *S. arbusculoides* to *S. arbuscula* Linnaeus, and at this time he proposed a *S. arbuscula* *labradorica*, a name later omitted by him. He did not cite a type for it, and only stated "Labrador." In describing his *S. arbusculoides* he gave as type specimen "Prince Albert's Sound (Mietscherling)," and he added "Raë River (Dr. Raë)," and "et in Labrador." (In 1858 he wrote "Miertsching" and "Roe.") Later in the Prodrumus Andersson proposed a new name, and said of *arbusculoides* "nomine incaute graeco-latino delendo." Here he cited Labrador with a ?. In 1867 as well as in 1868 Andersson has two varieties: var. *puberula* and var. *glabra*.

Bebb, in 1890, has already discussed this species, and stated that "Prof. Macoun who examined Andersson's types for me in the Kew Herbarium, says, that the specimens of Mieschring and Dr. Raë are all on one sheet with no means of telling to which, respectively, the labels belong; that they comprise apparently two or more species and are very imperfect, a few bearing young catkins." I have had no opportunity to compare these specimens but have examined copious material of this species from which I am able to draw the diagnosis given below.

It has been described, too, by von Seemen (1895) as *S. saskatchewanana* who based his species on Hooker's *S. acutifolia* of which I have seen the type. Von Seemen does not refer to *S. arbusculoides* or *S. humillima*, and probably did not know Bebb's note. According to a fragment of Von Seemen's type his species is nothing but Andersson's var. *glabra*, and certainly not a form of specific rank. Of the typical *S. arbusculoides* the following description may be given to enable a better understanding of this little known species.

Frutex in regione arctica humilis sed apud Dawson fide cl. Eastwood interdum arbuscula ad 3-6 m. alta ramis rubescentibus nitidis erectis vel interdum pendentibus; ramuli ab initio glaberrimi vel novelli minute puberuli et cito glabrescentes, hornotini olivacei vel ut annotini atrofusci vel casteani, nitiduli, dein atro-purpurascetes; gemmae floriferae (Eastwood

No. 16) conicae, subrostratae, apice subrecurve, ad 8 mm. longae, fuscae, nitidulae, glabrae, foliiferae ut videtur magis ovoideo-oblongae, breviores. Folia adulta chartacea, minora lineari-lanceolata, majora anguste lanceolata, rarius anguste elliptico-lanceolata, 1.5:0.4 ad 8:1.3 vel in ramulis vegetioribus ad 9:1.8 (vel in No. 467 Eastwoodiae ad 12:2.8 vel 14:2.3) cm. magna, utrinque acuta vel apice sensim breviter acuminata, subintegra, vel plus minusve dense breviter glanduloso-serrata, dentibus 1-20 pro 1 cm., superne ut videtur saepissime ab initio glaberrima vel novella pilis sparsis brevibus adpressis praedita, intense vivide viridia, nitidula, laevia, costa flavescenti nervisque lateralibus planis vel parce prominulis et laxe graciliter reticulata, in epidermide haud stomatifera vel stomatibus plusminusve numerosis (saepe tantum ad costam) praedita, subtus discoloria, glaucescentia vel fere albescentia, initio (infimis exceptis glabris) dense adpresse sericea pilis argenteis saepe cum fulvis mixtis, vel tantum parce pilosa et demum plusminusve vel omnino glabrescentia, adulta interdum parce fulvo-sericea, costa flavescenti prominula nervis lateralibus utrinque ad 14 tenuiter prominulis parallelis angulo acuto circ. 40-45° a costa abeuntibus, vix vel tenuissime reticulata; petioli superne sulcati et (saltem initio) minute puberuli, (2-) 4-8 (-11) mm. longi; stipulae nullae vel distinctae, lineari-lanceolatae, glanduloso-serratae, vix ultra 5 mm. longae, in surculis interdum latiores brevioresque. Amenta praecocia vel subcoetanea, anguste cylindrica, subsessilia, mascula (1-) 1.5-4:1 cm. magna, elongata, saepe subcurvata vel flexuosa, basi pedunculo 1 ad vix 5 mm. longo foliolis minimis linearibus normalibus vel squamiformibus 2-3 instructo; bractee oblongae vel subobovato-oblongae, apice obtusae vel subretusae (sed in eodem amento etiam subacutae) vel angustiores et acutiores, semper fusciscentes vel atrobrunnescentes, sparse et satis breviter vel ad apicem densius longe sericeae; stamina 2, filamentis glabris liberis vel imo basi brevissime coalitis, demum bracteam duplo superantibus, antheris parvis subglobosis vix 1 mm. longis in vivo ut videtur purpurascens: glandula 1, ovoideo-conica vel ovoideo-rectangularis, apice late truncata, saepe leviter emarginata, 2-2½-plo longius quam lata; amenta feminea sub anthesi pedunculo brevi excluso 1.5-3.5:0.5-0.6 cm., fructifera 2:1 ad 6:1.2 cm. magna, pedunculo circ. 3-8 mm. longo ut in masculis foliolato suffulta; bractee ut in masculis, fere semper obtusae, forma pubescentiae variabiles; ovaria ellipsoideo-conica, dense breviter sericeo-tomentosa; styli 0.2-0.8, rarius ad 1 mm. longi, saepissime subbifidi, stigmatibus parvis brevibus bifidis divaricatis iis aequilongis (vel initio sublongioribus); glandula ut in masculis, interdum vix longior quam lata sed saepissime 2-3-plo altior; fructus maturi tenuius quam ovaria tomentosi, e basi ellipsoideò vel ovoideo plusminusve rostrati, 5-7.5 mm. longi, pedicello 0.5-1.25 mm. longo excluso.

SPECIMENS EXAMINED: NORTHWEST TERRITORIES. Fort McPherson, July 11, 1904, *E. A. Preble* (Nos. 350, 351, fr.; W.); Fort Norman, Mackenzie, June 12, 1904, same coll. (No. 322, f.; W.); half way between Fort Rae, Great Slave Lake, and MacTavish Bay, Great Bear Lake, Lake St. Croix, August 10, 1903, same coll. (No. 247, st.; W.; forma ad var. *glabram* referenda); Great Slave Lake, Loon

Island, fifty miles north of Fort Resolution, July 10, 1901, *E. A. & A. E. Preble* (Nos. 133, 134, f.; W.); Slave River, about 45 mi. from mouth, August 29, 1914, *F. Harper* (No. 99027, st.; O.); Fort Resolution, July 14, 1901, *E. A. & A. E. Preble* (No. 151, st.; W.); June 21, 1903, *E. A. Preble* (No. 201, f.; W.); Nahami Mts., June 6, 1904, same coll. (No. 317, f.; W.); Churchill, Hudson Bay, August 2, 1910, *J. M. Macoun* (No. 79152, fr.; O.)

YUKON TERRITORY. Vicinity of Dawson, island near footbridge, July 13, 1899, *R. S. Williams* (fr.; N.); same vicinity, April 26, 1914, *A. Eastwood* (No. 16, winter-buds; A.); June 29, 1914, same coll. (No. 31, st.; A.; ad var. *glabram* spec-tans); May 21, 1914, same coll. (No. 56, partim, f.; A.; ut praecedens); May 14, 1914, same coll. (Nos. 56, partim, f., 57, m.; A.); May 15, 1914, same coll. (Nos. 64, m., 65, f.; A.); May 21, 1914, same coll. (Nos. 85, f., 87, m.; A.); May 23, 1914, same coll. (Nos. 98, m., 99, f., 100, m.; A.); May 26, 1914, same coll. (No. 106, f.; A.); June 2 and 3, 1914, same coll. (Nos. 129, m., 130, f.; A.); July 13, 1914, same coll. (No. 217, fr. submat.; A.; var. *glabra*); July 14 and 15, 1914, same coll. (Nos. 229, 239, 240, fr.; A.); June 19, 1914, same coll. (Nos. 301, st.; var. *glabra*; 302, fr.; A.); West Dawson, July 16, 1902, *J. Macoun* (No. 54402, st.; O.: "a small straight tree"); trail to Moosehide, July 1, 1914, *A. Eastwood* (No. 467, st. surc.; A.); islands in Klondike River, July 15, 1902, *J. Macoun* (No. 54401, fr.; O., partim var. *glabra*); Colorado Pup, July 29, 1902, same coll. (No. 54400, st.; O.); Ogilvie, July 8, 1914, *A. Eastwood* (No. 540, st.; A., var. *glabra*); Hard Luck Slough, July 10, 1914, same coll. (No. 565, fr.; A.); Cormacks, July 1, 1914, same coll. (No. 584, st.; A.); Carcross, Lake Bennett, July 16, 1914, same coll. (No. 725, st.; A.); Ingersoll Islands, moist sloughs and river bottoms, May 28, 1899, *M. W. Gorman* (m., f.; N.; "this willow is much eaten by Moose").

ALASKA. White Pass, July 23, 1914, *A. Eastwood* (No. 860, fr.; A.; an uncertain form of which the young leaves are rather tomentose along the under side of the midrib); Fort Gibbon on Yukon River, August 1, 1905, *C. N. H. Heideman* (No. 83, st.; W.; forma incerta; surculi foliis elliptico-lanceolatis membranaceis ad 10:2.2 cm. magnis breviter acuminatis subtus glaucis tenuiter brevissime adpresse sericeis stipulis linearibus).

ALBERTA. Jasper Park, near Jasper, July 22, 1917, *J. M. Macoun* (No. 95376, st.; A., O.); Athabasca River, July 23, 1918, same coll. (No. 95373, fr.; A., O.), same River, near bridge, east end, mixed alluvial soil and gravel, June 20, 1918, same coll. (Nos. 95750, m., 95751, fr. submat.; 95769, f.; 95770, m., f.; A., O.)

The localities of Drummond's specimens are uncertain. They are preserved in Herb. N. under "No. 61, Hb. H.B. & T.," fr., "marshes near Rocky Mts.," "No. 62, Hb. H.B. & T." f., and "No. 63, Hb. H. B. & T." st. No. 62 is Drummond's No. 663.

As a variety may be kept

S. arbusculoides var. *glabra* Andersson in Svensk. Vet.-Akad. Handl. vi. 148 (Monog. Salic.) (1867). — *S. acutifolia* Hooker, Fl. Bor.-Am. II. 150 (1839), non Willdenow. — *S. humillima* var. *glabra* Andersson in De Candolle, Prodr. xvi.² 248 (1868). — *S. saskatchavana* von Seemen in Bot. Jahrb. xxi. Beibl. 52, 7 (1895). — *S. saskatchewana* Rydberg, Fl. Rocky Mts. 198 (1917). — This is probably nothing but a glabrescent form and needs further observation. I refer to it the specimens mentioned as var. *glabra* in the enumeration above, and Richardson's plant from Fort Franklin preserved under "No. 65 Hb. H.B. & T." in Herb. N.

As to the true relationship of *S. arbusculoides* I do not wish to make a definite statement. Sometimes the leaves have rather numerous stomata

in their upper epidermis but not unfrequently I could not detect any trace of them. The length of the style and of the pedicel varies to a certain degree, and the shape of the gland is not always alike. These variations need further study. As to the Yukon plant at Dawson Miss Eastwood in a field note makes the following statement: "In habit it is variable but is generally tall and erect with dark red glossy stems. Some bushes have pendent branches, and some have almost fastigiate branches. It often becomes 10-20 feet high, and forms a great deal of the Willow growth along sloughs. It is common along the fence near the barracks, and in the slough on Fifth Street where the bridge crosses. It is one of the features of the vegetation in the town."

The second species of doubtful affinity is

S. argyrocarpa Andersson in Svensk. Vet.-Acad. Handl. vi. 107, t. 6, fig. 60 (Monog. Sal.) (1867); in De Candolle, Prodr. xvi.² 233 (1868). — Bebb in Bull. Torr. Bot. Club, xvi. 211 (White Mt. Will. III) (1889); apud Watson & Coulter, Gray Man. ed. 6, 483 (1890). — Britton & Brown, Ill. Fl. I. 500, fig. 1190 (1896); ed. 2, I. 603 fig. 1484 (1913). — Britton, Man. 318 (1901). — Robinson & Fernald, Gray's Man. ed. 7, 327, fig. 664 (1908). — Von Seemen in Ascherson & Graebner, Syn. Mitteleur. Fl. iv. 92 (1909). — *S. repens* ? Bigelow, Fl. Bost. ed. 3, 392 (1840), non Linnaeus. — Carey apud Gray, Man. 430 (1848). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858). — *S. fusca* Oakes in Mag. Hort. Bot. Harvey, vii. 184 (Not. Rar. Pl. New Engl. 7) (1841), non Linnaeus. — *S. ambigua* Tuckerman in Am. Jour. Sci. xlv. 35 (1843), non Ehrhart. — *S. labradorica* Schw. in Herb. ex Bebb in Bull. I. c. 211 (1889), nom. nudum. — *S. argyrocarpa sericea* Andersson in Svensk. Vet.-Akad. Handl. vi. 107 (Monog. Sal.) (1867); in De Candolle, Prodr. xvi.² 234 (1868). — *S. depressa* Barratt in Herb., nom. nudum, non Fries.

Bebb (1889) has dealt with this Willow quite extensively. The synonymy given above furthermore shows how this species has been treated by previous authors. I am not sure whether Pursh's *S. repens* (Fl. Am. Sept. 610 [1814]) really is the same as our species. He had a Willow in mind that came from "Nova Scotia and New Foundland," and was "a very small creeping species." I have not yet seen specimens that agree with Pursh's description which apparently is partly taken from Willdenow. Pursh says that the ovaries are pubescent but the capsules glabrous. Von Seemen seems to have been the first who observed the presence of two glands in the male flowers, and he therefore placed this species with *S. glauca*. In my opinion it cannot be referred to sect. *Glaucæ*, and may represent the type of a special group.

Besides var. *sericea* which is nothing but the type Andersson in 1867 described as var. "*glabrior*: foliis magis aequalibus, supra nitide, subtus opacoviridibus denudatis" which name he (1868) changed into var. *denudata* where he says: "foliis utrinque glabris, subtus opace viridibus, iis *S. pedi-*

cellaris subsimilibus." Not citing a type specimen it is almost impossible to tell what Willow Andersson may have had before him.

I have been able to examine specimens from the White Mountains in New Hampshire, from Table-top Mountain in Gaspé Peninsula and from various localities in southern Labrador.

When I dealt with the species of section *Glaucæ* in my 2nd and 3d notes (see Bot. Gaz. LXVII. 58 [1919]) I omitted a curious species described by Rowlee as *S. Maccalliana* of which he said that it is "obviously related to *Salix glaucops* Anders., but differs in having glabrous serrate leaves. Its leaves and buds suggest *S. lucida*." After having examined probably all the material preserved in American herbaria up to 1919 I suppose that *S. Maccalliana* indeed can be regarded as a member of this group because the flowers show a strange similarity to those of *S. glauca* var. *glabrescens*. The male flowers have a dorsal gland, and the pubescence of the straw-colored or light brown bracts is short. The leaves, however, present a wholly different aspect, and somewhat resemble those of forms which Ball names *S. pseudomyrsinites*, a species of the *Cordatæ* group. I will give the following precise description and enumerate the specimens.

S. Maccalliana Rowlee in Bull. Torr. Bot. Club xxxiv. 158 (1907). — Henry, Fl. S. Brit. Col. 97 (1915). — Rydberg, Fl. Rocky Mts. 198 (1917). — Frutex 1–2 m. altus, ut videtur erectus, strictus, ramosus; ramuli novelli sparse pubescentes, cito glabri, ? balsamei, hornotini olivacei vel purpurascens, saepe ut annotini biennesque castanei, nitiduli, vetustiores ignoti; gemmae bene evolutae nondum visae. Folia matura crasse chartacea, inferiora minora pedunculorumque anguste vel lineari-lanceolata vel oblanceolata, gradatim in superiora majora anguste elliptico-lanceolata vel anguste elliptico-oblonga abeuntia, basi acuta vel obtusa, apice subacuta vel subacuminata, 1.5 : 0.5 ad 6.5 : 1.6 vel in surculis ad 8(–9) : 2.5 cm. magna, margine incrassato distincte glanduloso-crenato-dentata dentibus circ. 2–4 pro 5 mm., superne novella pilis griseis fulvisque saepe satis difficile recognoscendis obsita, in costa saepe densius pilosa, demum subito satis vel omnino glabrescentia, intense viridia (in vivo nitidula?), costa nervisque lateralibus flavescentibus plusminusve planis et subtiliter reticulata, in epidermide stomatibus satis magnis ellipticis subnumerosis instructa, subtus initio ut superne pilosis et demum glabra, viridescencia, vix vel paullo pallidiora, ? subnitidula, costa elevata nervisque lateralibus utrinque circ. 8–14 prominulis et etiam tenuiter reticulata; petioli 2–8 mm. longi, flavo-brunnei, superne sulcati et pilosuli; stipulae etiam in surculis non visae. Amenta coetanea, pedunculata, rhachi villosa, mascula ovoideo-cylindrica, pedunculo brevi (vix ultra 8 mm. longo) foliola 3–4 normalia ad 2 : 0.6 cm. magna gerente excluso 1.5–2 : 1.2 cm. magna, densiflora; bracteae anguste obovato-oblongae, apice rotundae, flavescentes, breviter pilosae, sed versus apicem plusminusve glabrescentes, venosae; stamina 2, filamentis liberis, circ. $\frac{1}{3}$ pilosis bracteam demum duplo longioribus, antheris flavis ellipsoideis

circ. 1.5 mm. longis; glandulae 2, ventralis ovoideo-conica vel saepe bipartita, bractea subtriplo brevior, dorsalis minima interdum plusminusve 3-partita; amenta feminea sub anthesi nondum visa, adultiora circ. 3.5-4: 2 cm. magna (pedunculo ad 1-2 cm. longo 3-4-foliolato excluso), basi plusminusve laxiflora, fructifera ad 5:1.6 cm. magna; bracteae ut in masculis, saepe omnino breviter pilosae; ovaria anguste ovoideo-oblonga, dense breviter argenteo-sericeo-tomentosa; styli distincti, 0.8-1.3 mm. longi, apice saepissime bifidi, stigmatibus oblongis divaricatis bifidis stylo paullo ad duplo brevioribus; pedicelli initio glandulam duplo dein ad triplo superantes, in fructu circ. 2 mm. longi; glandula 1, late ovoideo-rectangularis, saepissime bipartita. Fructus maturi e basi ovoideo-rhombica rostrati, 8-10 mm. pedicello excluso longi; ut ovaria tomentosi.

SPECIMENS EXAMINED: ALBERTA. Edge of Bow River, near Cave and Basin, about 1500 m., July 10, 1899, *W. C. McCalla* (No. 2252^a, partim, f.; N.); vicinity of Banff, on water's edge along road to Sun Dance Canyon, about 1500 m., July 10, 1890, same coll. (No. 2252^a, partim; Cor.; "about 1 m. high"); low ground along road to Devil's Head Lake, about 1500 m., June 19, August 11, 1899, same coll. (No. 2252, type, m., st.; Cor. "1.5 m. high"); Banff, August 13, 1908, *Olson* (f.; G.); Morley, foothills of Rocky Mts., damp places, June 17, 1885, *J. Macoun* (No. 24506; O.; olim No. 17, C.); Banff, Cave Avenue, July 4, 1891, same coll. (No. 24517, fr.; O.; olim nos. 28 and 33 in C.); marshy flat near the Bow River, July 15, 1891, same coll. (No. 28, fr., C.; "bush 1.2 m. high"); Spray River, June 30, 1891, same coll. (No. 33, fr.; C.; "low spreading bush on the borders of the same marsh").

BRITISH COLUMBIA. Yale District, Armstrong in the Okanagan Valley, 1912, *E. Wilson* (No. 2, f., m., fr.; Cor.; in O. sub No. 87817); Kootenay District, Cranbrook, June 22, 1914, *J. K. Henry* (fr.; Cal.; "clumps 1.2 to 1.8 m. high").

SASKATCHEWAN. Prince Albert, Camp, thickets by railway, July 6, 1876, *J. Macoun* (No. 13675, st.; Cor., O.); west of Eagle Creek, Bare Hill, in a bog, July 31, 1906, *J. Macoun & W. Herriot* (No. 70260, st., O., G.).

MANITOBA. In thickets east of Brandon, June 6, 1896, *J. Macoun* (No. 13666, fr. im.; C., Cor., O.).

ONTARIO. Thunder Bay District, Lake Superior, north shore, by C.P.R.R. in SW. between Port Arthur and Fort Williams, July 23, 1883, *W. R. Dudley* (f.; C.). VIENNA, *May*, 1920.

THE LIGNEOUS FLORA OF THE STAKED PLAINS OF TEXAS

ERNEST J. PALMER

THE traveler who has passed over the high, wind-swept, grassy plains of the Texas Panhandle and viewed the country only from the speeding train might perhaps imagine that an article on the trees and shrubs of the region could be as brief and trite as the celebrated treatise on the Snakes of Ireland; but a closer inspection will reveal the fact that even if Nature has essayed a sinister imitation of St. Patrick's rôle upon the ligneous flora here it has been carried out but indifferently, and that although largely confined to certain limited areas woody plants are by no means rare and the total number of species is not inconsiderable. Moreover, instead of showing any tendency

to abandon the country, both in area occupied and in number of forms, there appears to be a steady if slow increase in progress at the present time.

The southern portion of the Great Plains, occupying western Texas, rises gradually or by a series of step-like plateaus from the lower Rio Grande valley, with a maximum elevation of only a few hundred feet above sea-level, to the high plains of the Panhandle, parts of which exceed four thousand feet in altitude. The first of these, if we exclude the Rio Grande Plain, which properly belongs to the Gulf Coastal Plain, is the Edwards Plateau, set off from the lowlands by the bold Balconies Escarpment; the second is the Staked Plains, lying to the northwest of the rocky plateau and rising gradually from it. The boundary between these two regions must, therefore, be somewhat arbitrarily drawn, but in general it may be regarded as following the line of contact between the limestones of the Comanchean Series and the overlying Tertiary or Quaternary deposits, principally of gravels, sands and other unconsolidated materials, that constitute the surface formations of most of the Staked Plains area. This line runs in a southwesterly direction from near the town of Big Spring, in Howard County, to the valley of the Pecos River, in Crane County, which it follows thence at an angle of about forty-five degrees northwestward into New Mexico. On the eastern side the plateau rises abruptly from the lower bordering plain by a high escarpment or line of cliffs, the crown of which is formed by a hard, thick stratum, usually of the recent, non-marine limestone or "caliche." The more resistant nature of this upper layer is responsible for the bold character of the cliffs, and it is locally known as the "cap-rock" or "rim-rock." The escarpment is also well defined on the north, where it forms a wall of the deep valley of the Canadian River, which separates the Staked Plains from the next successive, higher stage, the Panhandle High Plains. On the west it is bounded by the valley of the upper Pecos River, in New Mexico. The margins of the plateau are in places deeply incised by the canyons of streams which have their sources in the highlands. The most important of these are on the eastern side the various branches of the Colorado, Brazos and Red Rivers, and on the west those of the Pecos. It is in these canyons and along the ravines and broken ground bordering them that most of the ligneous plants are found, and many of them are confined to such protected situations or to the marginal escarpment of the plateau.

Viewed as a whole the Staked Plains is a high, mesa-like tableland, with a remarkably level surface over its interior, and nearly destitute of running streams. The rainfall is sparse, the annual average ranging from fifteen to twenty-five inches, and its elevation and exposed position in the vast plains stretching unbrokenly from the Arctic Ocean to the Gulf of Mexico, gives it a somewhat rigorous climate, marked by great extremes of temperature, both seasonable and diurnal. Dry winds of high velocity prevail during the greater part of the year, and under their influence the potential evaporation is much greater than the total average rainfall. In addition to the normal severity and wide variations of the climate its effect upon life

conditions is augmented by the frequent tornados, blizzards and long periods of drouth to which the region is subject.

The broad plains forming the summit of the plateau present for many miles an almost featureless surface. The streams, so-called, are merely wide, shallow stretches of gravel and sand, devoid of running water or even pools except for short periods after the infrequent rains. Their courses are generally comparatively straight, with very slight fall and practically without banks.

Ascending from the lower level over the steep grades or precipitous passes of the escarpment the appropriate significance of the colloquialism, "on the plains," is apparent. Far as the eye can see extend the unbroken, grassy stretches of level surface, conveying an impression of boundless space comparable only to the great sandy deserts or to the ocean. The only natural features that vary the landscape are here and there broad, shallow depressions or sinks, defined by the deeper green of their more luxurious herbage, and perhaps the far-flung glistening ribbon of one of the waterless streams in the distance. In the refracted light of the dazzling summer sun may be seen the inverted images of cattle, buildings, fences and trees along the horizon on either hand, mirrored in the phantom lakes of the mirage. Scarcely more marked or impressive in the magnificent distances than the few and slight inequalities of nature are the tangible evidences of civilization: the ranch houses and stock sheds with the ever-present windmills, many miles apart; fences and roads no less remote, and the grazing herds of cattle that have come with the plainsmen and cowboys as successors to the once numberless buffalo and the nomadic Indians, that not many years ago held undisputed sway over these broad prairies. The traveler is sometimes startled into a realization of how very recent is the period of this great cultural transition by coming upon the whitened skulls of the bison, still occasionally to be seen about salt licks or along the streams, or by turning up the flint or obsidian arrow-heads of the primitive hunters.

Underground solution of salt, magnesia and other mineral matter has resulted in the formation of the numerous shallow depressions that are in many places so conspicuous a feature of the plains topography. These are sometimes many acres in extent but seldom more than a metre or so below the general level at their greatest depth, and as the sides slope gently towards the centre they appear to be even shallower. Following the heavier rains many of these sinks become shallow lakes, but this condition generally continues for only a short time. Practically all of the water disappears in a few days or weeks at most by evaporation, very little of it sinking to any great depth into the ground. After the water is gone a rank growth of coarse grasses and rushes springs up, and as the herbage on the level plain becomes dry and brown the contrast in color is quite striking.

The flora of the open plains is essentially grassy; species of *Bouteloua*, *Andropogon* and *Festuca* being very abundant. Many annual and perennial species of flowering plants are found but most of them are conspicuous only for a short time after the rainy season. Low mat-like forms are common,

with wide-spreading branches close to the ground the better to resist the constant buffeting of the dry winds. Owing to the generally light rainfall and rapid evaporation the subsoil contains little moisture and this condition, together with the great depth of ground water, offers little incentive to deep-rooted plants, those having wide-spreading, shallow root systems being the prevailing types. Ligneous plants are almost entirely absent. Occasional stunted bushes of Mesquite and the low Cat's Claw (*Mimosa borealis*) or the shrubby Senecio may sometimes be found along the slight depressions of stream beds and ravines.

The Mesquite (*Prosopis glandulosa*), which is the most frequent woody species, is here strictly shrubby, seldom attaining a height of more than one or two metres. This plant, which makes a small tree under favorable conditions, with a maximum height of twelve or fifteen metres and a trunk diameter of four or five decimetres, is everywhere in this region the most hardy pioneer of advancing forestation. It has extended its range from its original home, probably south of the Rio Grande, until it now occupies all of the lowlands of the Rio Grande plain, the lower open canyons of the Edwards Plateau and those of the Staked Plains, encircling these tablelands and extending westward through the canyons and river valleys of New Mexico and Arizona and northward into western Oklahoma. Scattered specimens are found as far north as southwestern Kansas and eastward in Texas to the boundary of Louisiana. As the most abundant and widely distributed ligneous plant over hundreds of square miles it is familiar to all travelers in the Southwest, and numerous accounts of it appear in the literature, both scientific and general, dealing with that part of the country. Over a large part of western Texas it is the only species that attains the size of a tree and it is therefore of the greatest value to the ranchers and settlers in the construction of fences as well as for fuel and other purposes. The wood is of rapid growth and rather durable; the beans and foliage are eagerly eaten by stock and furnish a valuable addition to the forage at times when grass and other herbage is dried up. Although the thin foliage affords but indifferent protection from the scorching summer sun, as the only refuge, often, in a dry, hot land its shade is most grateful both to man and beast. The testimony of travelers and early settlers in western Texas agrees that Mesquite was absent or rare not many decades ago in much of the region where it is now so abundant. While evidence of this sort must always be received with caution there can be little doubt that it has advanced widely to the northward and eastward in recent years and that the forward movement is still going on with undiminished rapidity. One of the stories told of its introduction into Texas is as follows:

At an early day in the history of the territory when the Franciscan padres were establishing missions in the San Antonio country and zealously striving, under the banner of the cross, to bestow the blessings of the true faith upon the benighted natives, while Spanish adventurers from Mexico were seeking no less assiduously, by argument of the sword, to separate them from their more material possessions and to locate the fabulous

mines and rich cities of the interior, rumors of which had reached them from earlier explorers and from native traditions, the burrows, which were the pack animals of their caravans, were fed largely upon the beans of the Mesquite, and in this way the tree was first established in the country. My informant assured me that their route from the Rio Grande, up through the Spanish Pass northwest of San Antonio, towards San Saba and the interior, could formerly be traced by the growth of Mesquite along it, and that subsequently it had spread over the country in all directions from this nucleus. I cannot vouch for the authenticity of this account, but certainly the trail of the old Spaniards pointed out through the region is near the centre of distribution of the Mesquite in Texas and it does not seem impossible that it may have been, at least in part, introduced in this way. In recent years its dissemination over wide areas has been accomplished largely by the domestic animals that feed upon it. It is claimed that in the arid regions the seeds will germinate only after having passed through the stomachs of animals. Certain it is that the undigested seeds are often distributed and the plant established in this way.

Along the southern border of the Staked Plains there is a gradual transition from the flora, as from the topography, of the Edwards Plateau and a number of the more hardy woody species of the latter region persist for some distance into the plains. Some of the trees and shrubs find their northern limit about the buttes and ridges of Comanchean limestone that appear at intervals through the more recent residual deposits, but others reappear in the canyons or persist about the marginal rim of the elevated plains. Amongst those of the former class appear to be the Riverside Walnut, Western Red-bud, Live Oak, Mexican Buckeye and deciduous Coral Bean (*Prosopis affinis*); more persistent are the Shin Oak, the Red-fruited Juniper, Hackberry, Argireta (*Mahonia trifoliata*), Gum-elastic (*Bumelia texana*) and wild China (*Sapindus Drummondii*). In flats and depressions shrubby species from the Rio Grande Plain and the more arid regions to the southwest appear. Typical of these are the Creosote Bush (*Larrea tridentata*), the slender Cactus (*Opuntia leptocaulis*), *Rhus microphylla* and *Koeberlinea spinosa*.

The marginal escarpment of the plateau with its high, perpendicular cliffs, frequently overhanging ledges of cap-rock and deep indenting coves and ravines, affords protection to many plants that are unable to maintain themselves in more open situations; but as most of the ligneous species found here are also common to the canyons, some of which have worked far back into the interior, they will be mentioned in that connection.

The streams which traverse the upper plains, with their very slight fall and shallow channels, serve to carry off the surplus water after heavy rains. However, owing to the flatness of the country, the generally dry atmosphere and almost constant winds, the amount of water that reaches them is very small in proportion to the area, most of it remaining on the surface and disappearing in a short time through evaporation. Under these conditions there is little erosion through the action of the streams in this part of their

courses; but as they approach the marginal rim the grade becomes suddenly accelerated; cascades or rapids are formed as they plunge over the precipitous cap-rock or rush down the steep slopes of the escarpment. While the streams in this stage are intermittent and their work continues for only a short time after rainy periods they are at such times very active and the nature of the deposits they encounter is generally quite favorable for rapid excavation. After the hard stratum of cap-rock has been broken down, which is accomplished rapidly along the overhanging ledges, the soft under-lying strata are easily removed. When the level of ground water is reached, which in the high plains is often several hundred feet below the surface, springs begin to issue along the canyon walls and the streams become perennial.

The small streams forming the headwaters of Red River have worked out deep channels for many miles back into the interior of the plateau. The Paloduro Canyon in Randall and Armstrong Counties, the largest of these, is one of the most remarkable erosion features of the plains and of the entire Southwest. Beginning as several narrow, shallow ravines near Canyon City it rapidly deepens and widens until in some places its floor is from 800 to 1000 feet below the level of the plains and more than ten miles in width. This enormous amount of excavation has been accomplished by a small stream in comparatively recent geological times and the work of deepening and widening it is going on with undiminished force and rapidity at present. During the summer of 1918 several days were spent by me in exploring this canyon and in studying and making collections of the plants found in it and upon the surrounding plains. As the ecological conditions and flora are quite characteristic of this interesting phase of the Staked Plains the following notes on the trees and shrubs found in this canyon may be regarded as of general application.

Approaching the canyon in its deeper sections across the plains is an interesting experience. Before you lies the seemingly endless prairie, almost as level as a billiard table; in the distance, perhaps, you see a ranch house with its outbuildings and windmills; not a ripple marks the surface of the plain and there is no apparent obstacle to prevent you continuing in a direct course to the settlement. Suddenly you come upon a shallow ravine eating its way into the plain; some low Juniper or Mountain Mahogany bushes appear along an eroded slope for a few yards and then all at once you stand upon the brink of a precipice and at your feet lies a chasm some miles in width and several hundred feet deep. On the opposite side you make out the horizontal line of the plain which continues thence as if unconscious of the interruption. Far down below, the course of a tiny stream meandering through the broad valley is marked by a fringe of trees. The canyon walls are nowhere perpendicular for their entire height, as in some of the western canyons carved through harder strata, but fall away by a series of terraces, slopes and ledges, sometimes with outstanding pinnacles and masses carved into irregular and fantastic forms. There are numerous short but deep side canyons and ravines, which in many places afford the only avenues of descent into the main canyon.

Near the summit of the canyon walls there is a stratum of soft but comparatively durable limestone several feet in thickness, locally known as the "upper cap-rock." Above it there is sometimes a slope of gravel or calcareous sand a few feet in thickness; below there is another slope of only partially consolidated calcareous material, sometimes as much as fifty feet in thickness, resting upon a thick bed of sandstone of Triassic age. This latter formation, called the "lower cap-rock," varies greatly in character. In places it is from 50 to 120 feet in thickness and ranges from a sandy shale to a coarse grained sandstone or conglomerate. Below it are the "red beds" of the Permian, consisting of soft, friable sandstones, clay and gypsum. The brick-red color of these deposits, due to the iron oxide which they contain, is imparted to the waters of the stream and gives name and character to the Red River. These soft Permian strata yield readily to erosion and every rain carries away great quantities of material broken down by each rill and temporary torrent. Sections of the cap-rock are constantly being undermined through removal of the softer underlying deposits and huge masses of it frequently piled up at the base of the cliff or in the narrow side canyons. Balancing and "toadstool" rocks are frequent where detached masses of the sandstone surmount columns of the softer material. In such places the scenery of the canyon has quite the aspect of the "bad lands" of the Northwest, and amongst the innumerable hillocks and defiles of the more rugged parts it is hard to realize that one is in the midst of the plains and not in a mountainous country.

Below the level of the plains four principal zones of plant life may be recognized in the canyon. These are the calcareous beds above and below the upper cap-rock, including that stratum, the sandstone section of the lower cap-rock and the broken belt of the Permian deposits below it, the open, comparatively level floor of the main canyon, and the immediate borders of the river and perennial, spring-fed streams. For convenience these may be designated the Upper Cap-rock, Lower Cap-rock and Talus, Canyon-floor and River-bank zones.

The following woody plants were collected in Paloduro Canyon at several points in Randall and Armstrong Counties, Texas, but principally at the J. B. Gamble ranch south of Claude in the latter County, and the brief notes are based on observations made during a rather hasty visit:

Juniperus monosperma (Engelm.) Sarg.

This species, locally called White Cedar, is one of the most conspicuous if not the most abundant of the woody plants. It occurs from the Upper Cap-rock zone, where it is usually low and shrubby, through the Lower Cap-rock-talus zone into the deep protected side canyons. In the last named situations and below high protecting bluffs it sometimes becomes a tree 20 metres or more high and with a trunk diameter of 5 or 6 decimetres.

Juniperus Pinchotii Sudw.

The species was originally described from this locality and I am applying the name to the tree or shrub called Red Cedar in the canyons, with erect rigid branches and large copper-colored fruit. It is commonly not more

than a tall shrub, often sending up a number of stems from burned-off stumps. In more protected situations it becomes arborescent, the largest specimens observed being about 12 or 15 metres in height and 4 or 5 decimetres in trunk diameter. It is rather abundant in the same zones as the last species.

Ephedra Torreyana Wats.

This interesting shrub is usually found near the summit of the canyon walls in the Upper Cap-rock zone. Its naked, Equisetum-like stems are much branched and present a very curious appearance. It was also found near Channing, in Hartley County.

Populus texana Sarg.

One of the commonest and largest tree along the margins of the river, in the deep side canyons and under the protection of cliffs is the Cottonwood, which has recently been described by Professor Sargent under this name. While not attaining the large size of some of the other Cottonwoods, specimens 20 metres high and 75 or 80 centimetres in trunk diameter are frequent. The trunks are often bent and branched from near the ground. This species was observed in Nolan, Garza, Randall, Armstrong and Hemp-hill Counties, and doubtless occurs elsewhere in canyons of the Staked Plains and along the northern border of the Edwards Plateau and probably extends into southwestern Oklahoma.

Salix amygdaloides Anders.

A common Willow in the River-bank zone, both in the canyons and in more open situations wherever there are running streams or pools. A tree sometimes 10 or 12 metres high.

Salix exigua var. *stenophylla* (Rydb.) Schneid.

A shrub or slender tree found rarely in the River-bank zone and watered side canyons. Much more abundant along pool and stream margins in more open situations on the plains.

Quercus Mohriana Rydb.

Very abundant along the Upper and Lower Cap-rock-talus zones. Usually a shrub from one to three metres high, but in the protection of cliffs and in deep side canyons sometimes becomes a tree seven or eight metres high, with thick, rough, pale bark and a low conical crown. The leaves are quite variable in size and shape.

Celtis laevigata var. *texana* Sarg.

A small tree common in the Canyon-floor and River-bank zones, and less abundant in the higher zones of the canyon walls.

Mahonia trifoliata Moric.

This curious and rather pretty shrub of the arid Southwest, called Argireta by the Mexicans, is occasionally found in the Lower Cap-rock-talus zone.

Morus microphylla Buckl.

The Mexican Mulberry, a typical tree of the Edwards Plateau, appears to be rather rare except along the southern border in the Staked Plains. In the canyon a few specimens were seen in the Lower Cap-rock-talus zone.

Prunus angustifolia Marsh.

Found occasionally in small thickets in the Canyon-floor and River-bank zones.

Prunus virginiana var. *demissa* (Nutt.) Torr.

Growing in deep watered side canyons and under the protection of bluffs near water.

Cercocarpus argenteus Rydl.

A common and typical shrub of the Upper Cap-rock zone. Seldom more than two or three metres high.

Prosopis glandulosa Torr.

The Mesquite is one of the commonest ligneous plants in the canyon. It is most abundant in the Canyon-floor zone, where it becomes a tree, sometimes ten metres or more in height, but it is also found along the margins of the river and along the sides of the canyon to the upper plains. In the last-named situation it is struggling to maintain and extend a precarious foothold on the open, wind-swept surface, but it seldom becomes more than a shrub two or three metres in height.

Mimosa borealis Gray.

The low, thorny Cat's Claw grows in similar situations to the Mesquite but is perhaps commonest in the broken, rocky ground below the lower cap-rock.

Dalea formosa Gray.

This diminutive shrub is rather common in rocky ground of the Lower Cap-rock zone and is less frequent in the zones above and below.

Gleditsia triacanthos L.

There is a small grove of Honey Locust trees in the Club House grounds near Canyon City and it is said to occur sparingly elsewhere in the upper part of the canyon. The trees seen are of small size for the species, averaging, perhaps, eight or ten metres in height. It appears to be absent lower down in the canyon.

Amorpha fruticosa L.

Rather frequent in the River-bank zone and in low places of the Canyon-floor zone.

Amorpha canescens Pursh.

Collected along the banks of a small ravine above the upper cap-rock. Apparently not common.

Glossopetalon spinescens Gray.

This is one of the most interesting shrubs found in the canyon from the standpoint of plant distribution. On the Edwards Plateau I observed it only along the western and southern borders in Uvalde County and in the Devils River region, where it seems to have come in from the Trans-Pecos country. In the Paloduro Canyon it grows on calcareous banks of the Upper Cap-rock zone. It was seen near Canyon City, in Randall County, and south of Claude, in Armstrong County.

Ribes aureum Pursh.

In deep canyons and along protecting cliffs in the Upper and Lower Cap-

rock-talus zones. Found in Noran, Irion, Garza, Randall, Potter and Armstrong Counties, also in Woodward County, Oklahoma.

Ptelea trifoliata var. *mollis* Torr. & Gray.

Not uncommon on dry rocky banks and in open situations throughout the canyon.

Rhus trilobata Nutt.

Abundant on rocky banks in the Lower Cap-rock-talus zone and less frequent in the zones above and below it.

Rhus microphylla Engelm.

A common shrub in the open Canyon-floor zone and not uncommon in the Lower Cap-rock zone.

Rhus Toxicodendron L.

Grows as a low shrub, usually less than a metre high, in the protection of bluffs. Most abundant in the Upper Cap-rock zone. The scandent form was not observed anywhere in the Staked Plains.

Opuntia leptocaulis DC.

Common in the Canyon-floor zone and extending into the zone above.

Atriplex canescens (Pursh) James.

A common shrub in the Canyon floor and Lower Cap-rock zones.

Zizyphus obtusifolius Gray.

One of the commonest shrubs in the Canyon-floor zone and extending into the zone above.

Sapindus Drummondii Hook. & Arn.

The Soapberry, usually called Wild China or Wild Chinaberry in Texas, is a common tree in the canyon, generally growing in the open ground of the Canyon-floor zone or on the river banks. It sometimes extends to the foot of the lower cap-rock.

Forestiera neo-mexicana Gray.

A common shrub on rocky banks from the Lower Cap-rock to the River-bank zone.

Forestiera pubescens Nutt.

In similar situations to the last but less common.

Lycium Berlandieri Dunal.

In the open ground of the Canyon-floor zone and extending into the zone above.

Lonicera albiflora Torr. & Gray.

Not very common on steep banks of side canyons and along the upper cap-rock.

Cephalanthus occidentalis L.

Frequent along river banks and in depressions of Canyon-floor zone.

Baccharis halimifolia L.

Not very common in the River-bank zone and along margins of spring branches in side canyons.

Baccharis salicina Torr. & Gray.

Occasional on gypseous banks below the lower cap-rock.

Baccharis Wrightii Gray.

A low shrub in open situations in the canyon and on the upper plains.

Bigelovia pulchella Gray.

On rocky banks of Upper and Lower Cap-rock zones.

Bigelovia graveolens (Nutt.) Gray.

A diffuse shrub, one to one and a half metres high, with densely canescent foliage and stems. Grows on calcareous or gypseous banks of Upper and Lower Cap-rock zones.

Brickellia Wrightii Gray.

On dry banks in Upper and Lower Cap-rock zones.

Artemisia filifolia Torr.

Often common in sandy open situations on the upper plains, and sometimes found in the canyon from the Upper Cap-rock zone to the canyon floor.

Clematis Simsii Sweet.

Found in deep-watered side canyons. Not common.

Celastrus scandens L.

The Bittersweet vine was noted in only one locality, in a protected situation at the head of a deep side canyon.

Vitis Longii Prince.

Commonly grows as a low shrub a metre or so high in the protection of low bluffs in the Upper Cap-rock zone. In the deeper side canyons and along bluffs of the Lower Cap-rock talus zone it sometimes becomes a vine several metres high. This species is also very abundant, in the shrubby form, in the deep sands bordering the Canadian River, farther north.

Vitis rupestris Scheele.

Low bushy plants, which from the leaf form appeared to belong to this species, were found at one point in the talus below the lower cap-rock. As there was no fruit it may possibly be only a form of the last-named species.

From the foregoing list it will be seen that the assemblage of woody plants in the canyons is a rather heterogeneous and remarkable one. It must be remembered, too, that even here the trees and shrubs constitute only a small proportion of the entire flora. While it is not within the province of this article to enter into a detailed description of the non-ligneous plants it may be noted that they appear to have been drawn from no less varied sources and an investigation of them may contribute largely to an understanding of the origin of the trees and shrubs with which they are associated. In the protection of high bluffs and at the heads of deep canyon branches, where perennial springs afford a considerable supply of water, the herbaceous growth becomes in places quite luxuriant. Dripping banks are clothed with the Venus' Hair fern (*Adiantum Capillus-Veneris*); there are mossy ledges and boggy beds of Equisetums, rushes and the tall plummy grass, *Phragmites communis*, and many other surprises in moisture-loving plants are encountered. Their presence in these canyons in the midst of the grassy plains, associated with a comparatively rich ligneous flora, and so far removed in many cases from the main body of their kind and kindred,

suggests many interesting questions. In seeking the answers the origin of the plains topography and especially that of the canyons must be taken into account no less than the present ecological conditions and the possible agencies of transportation that have coöperated in developing the flora and giving it its present composition.

All of the phenomena observable in the canyons serve to impress the observer with a realization of how rapidly the work of excavation is going on and how comparatively modern their entire history may be. The remarkable facility with which some of the small streams have been able to cut deeply for many miles back into the plains plateau is attributable not only to the generally soft character of the deposits encountered but also probably to a recent uplift of the region, after the streams had defined their present courses, thus increasing the gradient and augmenting their erosive activities as they approached the escarpment.

It was the writer's good fortune in one respect, although not conducive to comfort or successful plant collecting at the time, to be in the Paloduro Canyon during a very heavy rainfall. Through the greater part of a day and night the rain came down in torrents, and when it slackened on the following morning the little stream across which I had waded several times on stepping-stones, scarcely wetting my boots, had become a roaring torrent more than a hundred yards across in places; fences and water-gates had been carried away and many of the Cottonwood, Mesquite and other trees along the river margins had been uprooted and borne down stream through the undermining of the banks, which were still crumbling at a rapid rate. On every hand could be heard the crashing and booming of falling earth and rock. When it became possible to approach the walls of the canyon and enter the deep side galleries the destructive effects of the elemental warfare were everywhere apparent. Great sections of the cap-rock ledges had been undermined and had tumbled down into the stream or were piled up at the base of the cliffs and slides of rock and earth on a large scale were going on in the saturated and fragile beds for some time after the storm.

The new sections of unoccupied land thus constantly being exposed invite the settlement of such plant pioneers as can gain a foothold. The competition between these first settlers is usually very slight but not all of them that have the hardihood to attempt colonization on these often dry and sterile lands succeed or prosper. Many tragedies ensue, too, from the unstable nature of the rapidly changing surface; but gradually those species, amongst the plants available or such as fortuitously enter the area, which are best adapted to all of the conditions encountered establish themselves and become dominant.

In general the protection afforded in the canyons from the almost constant force of the dry winds of summer and the cold blasts of winter that prevail upon the open plains, together with the more abundant water supply and the diversity of surface and soil are favorable to the development of a rich and varied flora and make possible there the growth of many plants that cannot survive beyond their limits in the Staked Plains region. There

are no permanent human settlements in the Paloduro Canyon and probably no consecutive weather records have been kept, but I was assured that the average winter temperature is several degrees warmer than that of the open plains. Cattle are wintered in the canyons without feeding or artificial shelter and without losses such as occur in the open country above. Based upon a study of the wild life, principally the fauna, the United States Biological Survey has designated the canyons as extensions of the Lower Austral, while the surrounding plains area belongs to the Upper Austral zone.

The plants peculiar to the canyons appear to be emigrants from various sources. Most of them have doubtless advanced gradually or been transported directly over wide intervening distances by various agencies from the Edwards Plateau region to the south; some appear to have come in by way of the upper Pecos valley from extreme southwestern Texas, amongst them such woody forms as *Glossopetalon*, *Ephedra*, *Lycium* and various Composites; others have evidently worked their way along the margin of the plateau and thence up the canyons as they have excavated their way back into the interior; of this class probably are the Junipers, Hackberry, Shin Oak and Soapberry or Wild China; still others, like the Willows and Cottonwoods, may have been introduced from the northwest through the Canadian River valley. The Honey Locust, Bittersweet vine and some of the herbaceous species present special problems of peculiar interest as to their origin and method of introduction. In the case of *Gleditsia triacanthos* the rather heavy seeds must have been transported from sections far to the east or southeast, the lower Brazos valley or the valley of Red River in eastern Texas and Oklahoma being the nearest sections where it occurs, so far as I am aware.

One of the best internal evidences of a newly established or changing flora is the lack of completeness and general balance in its composition and organization as compared with that of the zone it occupies and similar adjacent regions from which its plant population must have been drawn. In a plant society long established this adjustment has been brought about by ages of keen competition and elimination, compelling each surviving member to make the most of every opening and every available space; while in a newly invaded region not only is there evidence of the somewhat confused mingling of the old and new elements but the recent emigrants are arranged in a more or less haphazard way and are apparently seeking their true position or experimenting on the possibility of finding a permanent place in the flora. This partial lack of symmetry and order in the plant society may, if the geological history and physiographic development of the region as well as of the ever changing boundaries of the flora are not kept clearly in mind, be as little explicable under the modern theory of plant succession as under the old discarded idea of special creation, by which each species was supposed to have been placed for definite useful purposes in the particular environment for which it was best fitted: for plants perfectly adapted to a region that has undergone profound climatic or physiographic changes do

not spring up spontaneously; they must find means and await opportunities for entering the new territory, and these may be long delayed, thus allowing less suitable species to occupy it temporarily in the absence of competition.

Considering the geographical position and ecological conditions of the canyons certain woody plants are as conspicuous for their absence as others are surprising by their presence. Possibly a more extensive and thorough exploration than I was able to make might discover some of the plants mentioned below, but in a careful though brief examination of some of the most typical and heavily wooded portions of the Paloduro Canyon I found no trace of them. Conditions in the River-bank zone of the canyon appear to be ideal for the growth of the Mexican or Riverside Walnut (*Juglans rupestris*), which is such a common and characteristic tree along all the streams of the Edwards Plateau, and which approaches the Staked Plains at least as near as Sweetwater, Texas, and extends northward into the Wichita Mountains of Oklahoma; but it does not appear to have as yet found means of entering the canyon. The Pecan, too, should thrive and easily maintain itself along the river banks were it once introduced, and it would have no very wide distance to bridge from the upper Pease River, in Hardiman County, Texas, where it was observed growing spontaneously. It is also surprising that only one species of Oak has found its way into the canyons, since several shrubby and arborescent forms occur not far to the south and east. The American Elm and Red Mulberry might both be expected in the River-bank zone, but neither of them were seen, although the former at least is growing in the valley of the Canadian River on the northern border and along the upper Colorado not far to the southeast. No species of Red Haws, Roses, Blackberries, Viburnums, Dogwood, Ash nor many other plants that might naturally be expected were seen.

The entire absence of many plant families and the poor representation of others which are largely developed in the surrounding country and some of which seem well adapted to conditions here, together with the miscellaneous character of the plants that have become established are all strongly suggestive of the extremely new and incomplete status of the flora. There are, too, so far as known, no endemic species and a general absence of well-marked varieties such as would naturally have been developed had many of the species been long isolated under the peculiar conditions obtaining in the canyons from the parent stock and normal habitat.

All this is in striking contrast to the peculiar canyon flora of the Edwards Plateau, where more or less modified representatives of a typical eastern flora occupy certain restricted areas. If the former may be compared to remnants of aboriginal tribes surviving in isolated fastnesses amidst an alien and conquering race, the assemblage of plants in the Paloduro and other canyons of the Staked Plains may better be likened to the heterogeneous society in process of formation and adjustment drawn from many sources to a newly opened land. Here, in fact, are found many of the phenomena of a flora in the making, and one that has not yet reached a state of even approximate equilibrium or attained a well-balanced and permanent form.

In speaking of the very recent history and development of these canyons and their flora it is not, of course, intended to imply that they are to be considered in terms of a few years or even centuries. Some of the Juniper trees in the Paloduro Canyon are probably not less than one to two hundred years old, and we have no reason to assume that in them we are looking upon the original patriarchs of their race; but in comparison with some of the adjacent physiographic regions and as measured by the standards of geologic time and biologic evolution both appear extremely modern. Some of the plants, on the other hand, may have appeared only in the last few years and other emigrants may be expected from time to time, some of which will be only transient while others will establish themselves and become in time conspicuous and important additions to the flora.

Probably the two principal agents in introducing new plants into the canyons are at present, as they have been in the past, wind and migratory birds. The large proportion of southwestern species and the absence or comparative paucity of those from the contiguous regions to the east and northeast is doubtless due to the circumstance that during the season when seeds of most plants ripen and can be transported and successfully sown the direction of both of these agencies is from the south or southwest northward. Some of the lighter seeds, with special provisions for transportation through the air, may be carried almost incredible distances by such strong and persistent winds as prevail upon the plains. As there are few inequalities on the surface to arrest their progress, they would in many cases find lodgment only, at least in situations where there would be any chance for them to germinate and survive, when swept into the canyons that lie across their northward course.

Many birds breed in the canyons and others in their passage northward, doubtless, stop for a time in its protection. It is to be regretted that no definite data can be given either as to the meteorology or ornithology of the canyons to determine their relative and absolute importance as agencies in plant introduction. Their investigation, however, would prove a most interesting and fruitful field for a local observer with the taste and opportunity for pursuing it. Amongst the birds noted in the Paloduro Canyon, which are persistent seed eaters and probable agents in plant introduction are the Western Mockingbird, Texas Quail, Texas Jay and species of Woodpecker, Vireo and Oreole. Other birds seen were the Canyon Wren, Horned Lark, Poor Will, Cliff Swallow and Western Chipping Sparrow, and I was reliably informed that both the Mexican and Bald Eagle are found.

An analysis of the list of forty-five woody species given for the Paloduro Canyon reveals the fact that no less than twenty-three, or more than half, produce fruit attractive to ordinary seed-eating birds; while the seeds of the Shin Oak and most of the Legumes might have been transported by larger birds or mammals. Fifteen, including the Willows, Cottonwood, Wafer Ash, Button Bush, Virgin's Bower and the Composites are more or less perfectly adapted to wind transportation. In view of the inference that birds have probably been one of the chief agencies in bringing new plants

into the canyons it may at first seem the more surprising that no representatives of the large Red Haw group and some of the other *Rosaceae*, whose fruit is so attractive and which are commonly transported through their migrations over wide areas, should have found their way here. The explanation is no doubt found in the fact that species of these groups are rare or absent from most of the Edwards Plateau region and from that to the southwest.

WEBB CITY, MISSOURI, April, 1920

A NEW SPECIES OF PISTACIA NATIVE TO SOUTHWESTERN TEXAS, *P. TEXANA*

WALTER T. SWINGLE

IN 1859 John Torrey¹ reported *Pistacia mexicana* HBK. as occurring in Texas in "Rocky ravines near the mouth of the Pecos, western Texas, October (fruit); *Bigelow*. A small tree."

In 1891 John Coulter² included the species *Pistacia mexicana* HBK. in his Botany of Western Texas, with a very brief description, ending with the following statement: "A small Mexican tree, with an edible nut,³ said to occur near the mouth of the Pecos."

In 1897 Asa Gray⁴ described fruiting material in some detail in his Synoptical Flora and, although he had not seen the flowers, transferred the species to the genus *Rhus* as the sole species of a new section, *Pistacioides*. The name *Rhus mexicana* Gray, is cited as having been published "in Patterson, check-list, 1892, 21," but this check-list (Patterson's Numbered Check-list of North American Plants, North of Mexico, p. 21. [Oquakwa, 1892]) gives merely a *nomen nudum*, "RHUS . . . 1690 Mexicana Gray," with no citations of the previously published *Pistacia mexicana* HBK.

In 1905 Vernon Bailey,⁵ in his Biological Survey of Texas, assigns the plant to *Schmaltzia* (a segregate of *Rhus*, based on *Rhus aromatica*, Ait.) as *Schmaltzia mexicana*, citing *Rhus mexicana* and *Pistacia mexicana* as synonyms, and notes its relationship to the *Pistacia vera* from which the pistache nut of commerce is obtained. He goes on to say, "In places in the canyons of the Rio Grande this large shrub grows in profusion, suggesting that the real *pistachio* also might succeed here."

Aside from occasional citations of the scanty information given in these

¹ Torrey, John. Botany of the Boundary, in Emory, William H., Report on the United States and Mexican Boundary Survey (34th Cong. 1st Sess. Senate Ex. Doc. No. 108). II. pt. 1, p. 44 (Washington, 1859).

² Coulter, John M. Botany of Western Texas, in Contributions from the U.S. National Herbarium, Washington, D.C. II. 67 (June 27, 1891).

³ This is an error, as the seeds are too small to be classed as edible.

⁴ Gray, Asa. Synoptical Flora of North America, I. 386, also p. 381 (Part 1, fasc. 2, June 10, 1897).

⁵ Bailey, Vernon. Biological Survey of Texas, in North American Fauna (U.S. Dept. Agriculture). No. 25, p. 30. (Washington, 1905.)

sources practically nothing else has been published regarding this Texas plant which has always been assumed to be *Pistacia mexicana* HBK.

In 1902 I began a study of the genus *Pistacia* in order to ascertain the botanical relationships of *Pistacia vera* L., the cultivated Pistache nut, which I was endeavoring to introduce into culture on a commercial scale in California, Arizona and other Southwestern States. I soon satisfied myself from a study of the material preserved in the principal old-world and American herbaria that *Pistacia mexicana* HBK. was very different from any old-world species, but in the absence of flowers it was difficult to come to any decision as to the true relationship.

In March, 1907, through the courtesy of Mr. C. S. Scofield, his assistant, Mr. F. D. Headley, the superintendent of the San Antonio Experiment Farm, was sent to the mouth of the Pecos River in Valverde County, Texas, to secure flowering specimens of this plant. Mr. Headley secured some good specimens of both sexes, with photographs. A study of this material showed at once that it could not belong to a species of *Rhus* as supposed by Gray, but was very near *Pistacia*.

In March, 1911, Prof. S. C. Mason, aided by Mr. Stephen H. Hastings and Mr. R. E. Blair, collected additional and much better material and photographs in the same general region near the junction of the Pecos River with the Rio Grande. This additional material, together with Professor Mason's ample notes made on this and on two previous trips in March and April, 1910, permitted me to get a very good understanding of the Texas species.

The *Pistacia mexicana* HBK. was based on fruiting specimens collected at Chilpancingo in the State of Guerrero about 750 miles south of Valverde County, Texas. In the principal American herbaria there is fairly abundant material from the States of Puebla and Oaxaca which adjoin Guerrero, and even from the type locality, Chilpancingo, Guerrero (U.S. Nat. Herb. No. 399406, E. W. Nelson No. 7065, "Side of Sierra Madre, above Chilpancingo," May 25, 1903, fruiting branch) and some from Jalisco and Chiapas, all of which doubtless belongs to *Pistacia mexicana* HBK. A single fruiting specimen in the National Herbarium at Washington, D.C. (No. 867188), collected by Mr. O. F. Cook (No. 60, June 1, 1906) from "rough limestone country between Nentón and Candelaria, Dept. de Huehuetenango in northwestern Guatemala near the Mexican border," may be the same species but looks somewhat different.

In May, 1912, Mr. C. A. Purpus collected abundant material at Tehuacan, Puebla (No. 5848), and sent it to me together with a good photograph showing the habit of the species. He also sent in May, 1912, a quantity of seed, of which a very small percentage (38 out of 1754) germinated, and gave rise to plants (C.P.B. No. 7581) now growing in the greenhouses of the Bureau of Plant Industry at Washington, D.C., and also in the open in California.

On the other hand, there is some good material, mostly of the fruiting specimens only, from the northeastern Mexican States of Coahuila, Nuevo

Leon and Tamaulipas, that seems very like the Texas plant and distinctly different from the true *Pistacia mexicana* HBK. of southern Mexico.

Thanks to this wealth of material of both the southern Mexican and the Texas Pistaches, I am now convinced that the Texas plants constitute a good species, for which I propose the name *Pistacia texana*, n. sp.

***Pistacia texana*, n. sp.**

Pistacia foliis subpersistentibus, foliolis plus minusve curvatis, obtusis, submucronatis, subspathulatis; fructibus maturis profunde rubro-brunneis.

Species affinis *P. mexicanae* sed foliis minoribus, foliolis paucioribus, plus minusve curvatis, plus minusve spathulatis, latioribus obtusioribusque, minus mucronatis; ramulis novellis minus pubescentibus; alabastris bracteisque minoribus et minus pubescentibus; fructibus maturis rubro-brunneis nec atro-purpureis et glaucescentibus; trunco fere e basi ramoso (non trunco simplice).

Leaves persistent or tardily deciduous, odd-pinnate, 5–10 cm. long and 2.5–4.5 cm. broad, usually 6–8 cm. long and 2.5–3.5 cm. broad; petiole 10–15 mm. long, or sometimes 20 mm. on male trees, flattened and very narrowly winged; rachis very narrowly winged, slightly pubescent above; leaflets 4–9, usually 5–8 pairs, often not strictly opposite, thin and netted-veined, 8–25 mm. long and 5–9 mm. broad, usually 12–20 mm. long and 6–8 mm. broad; mature leaflets broadly rounded, more or less spatulate, or more or less mucronate at the tip (half-grown leaflets wine-red, acute-lanceolate, acute at tip) tapering into a deltoid or subcuneiform base; lateral leaflets more or less curved and inequilateral; midrib usually much nearer the side of the leaflet toward the parent twig; and usually more or less curved with the concave side toward the parent twig; leaflets dark green and sparingly pubescent along midrib above, pale green and glabrous below; almost sessile (except the terminal leaflet which is narrowed into a petiolule 4–6 mm. long) margin entire, slightly recurved. Female inflorescences appearing just before or with the new leaves, loosely and simply paniculate, 4–6 or sometimes 7 cm. long, almost glabrous. Female flowers small, usually subtended by a small ciliate margined bract and two similar bractlets, all three usually wine-red at the tips; perianth none; ovary ovate or sub-globose; styles 3, two shorter ones with 2-lobed stigmas, one, the longer, with a 3-lobed stigma. Male inflorescences in compact panicles, 2–4 cm. long, much more crowded than the female panicles; anthers very evident, reddish yellow, sometimes wine-colored as are the tips of the bracts subtending the flowers and branches of the panicles. Fruits lenticular to oval, dark reddish brown and slightly glaucescent when ripe, 5–6 mm. long, 4–5 mm. broad and 2.5–3 mm. thick, usually containing no embryo. Young twigs slender, 1.5–2.5 mm. thick, slightly pubescent, reddish colored when young, grayish brown when one year old from scaling off of the white cuticle; flower-buds small, 1.5–2.5 mm. long, sparingly pubescent.

A small tree or a large shrub, usually branched from the base, 5–10 m. high with a spread of 5–10 or rarely 12 m. Diameter of largest trunks

20-25, rarely 30-35 cm. at 30 cm. from ground. Not uncommon on limestone cliffs, and on soils derived from the weathering of limestone along the Pecos River near its junction with the Rio Grande in southwestern Texas and along the Rio Grande near the mouth of the Pecos on both sides of the river in Texas and in Coahuila, Mexico. It grows densely crowded in the narrow ravines or vegas in the limestone near the mouth of the Pecos River.

The young foliage of this species is wine-red in early spring.

This new species, *Pistacia texana*, differs from *P. mexicana*, HBK. in having smaller leaves with fewer leaflets (4-9, usually 5-8 pairs, instead of 8-18, usually 12-16 pairs), which are more or less spatulate, broader and more obtuse at the tip, not so markedly mucronate and more or less curved. The young twigs are much less pubescent and have smaller and less pubescent flower-buds and bracts than in *P. mexicana*. The mature fruits of *P. texana* are dark reddish brown, slightly glaucescent rather than glaucous and purplish black, as in *P. mexicana*. The trunks of the trees of *P. texana* are much branched near the ground, while *P. mexicana* often (perhaps always) has a single trunk. The smaller branches are rough grayish brown whereas those of *P. mexicana* are smooth and often light brownish gray, almost silvery.

TYPE LOCALITY: Near Hinojose Spring, Rio Grande Valley, near the mouth of the Pecos River, about 20 miles west of Comstock, Valverde County, Texas. The type specimens (type and merotypes¹) were collected by S. C. Mason, March 18, 1911, from a pistillate tree marked III-XVII, M. 26, about two miles above Hinojose Spring. The male syntypes were collected by S. C. Mason, March 18, 1911, from a tree growing on the bank of Hinojose Spring. Both the female type and male syntype are specimens in the National Herbarium and merotypes of both are in the Arnold Arboretum herbarium.

Numerous other collections (all in flower) made near the mouth of the Pecos in Valverde County, Texas, by F. B. Headley in March, 1907; and by Prof. S. C. Mason in March and April, 1910, and again in March, 1911, are all paratypes¹ as are the following specimens: National Herbarium, No. 19714, Mexican Boundary Survey, labeled "*Rhus Scheidiana*," fruiting twigs; Columbia College [Torrey] Herbarium, Mexican Boundary Survey "No. 152, Rocky Ravines near the mouth of the Pecos. Bigelow," fruiting twig; N.Y. Botanical Garden Herbarium, Mexican Boundary Survey No. 152, labeled "*Pistacia mexicana* HBK., *Rhus pterotoides*," fruiting twig; National Herbarium No. 364672, E. N. Plank, "near Shumla, Valverde County, Texas, June 6, 1895," sterile twig; National Herbarium, Vernon Bailey No. 480-g, "Rio Grande near Comstock, July 29, 1902," with nearly ripe fruit; Arnold Arboretum, S. S. H[astings], No. 25, "On banks of Rio Grande near Comstock," April 9, 1910, flowering branches; Arnold Arboretum, E. N. Plank, "Cañons of the Pecos River, Texas," 1899, leaves only; National Herbarium No. 19717, Dr. Edward Palmer, "Coahuila, Mexico, 1880" fruits; Arnold Arboretum, Dr. Edward Palmer, No. 196 (N $\frac{1}{2}$), Saltillo, Coahuila, Mex., July 1-8, 1880, fruiting branch; National Herbarium No. 842129, C. A. Purpus No. 4888, "Sierra de la Paila, Coahuila," Mex., Oct. 1910, fruiting branches; Arnold Arboretum, C. G. Pringle, No. 1930, "Rhus Mexicana, Gray . . . Canyons of the Sierra Madre near Monterey," Nuevo Leon, Mex., June, 1888, fruiting branch; National Herbarium, No. 19716, C. G. Pringle, No. 1930 as above; Arnold Arboretum, "*Pistacia Mexicana* HBK., Monterey [Nuevo Leon, Mex.], Coll. C. S. Sargent," April 6, 1887, two fruiting branches;

¹ Swingle, Walter T., Types of Species in Botanical Taxonomy, in Science n. s. xxxvii, 864-7, (No. 962, June 6, 1913).

National Herbarium No. 332516, *E. W. Nelson*, No. 4445, "Road over mountain between Victoria and Jaumave Valley, altitude 800-2500 ft.," Tamaulipas, Mex., May 31, 1898, two fruiting branches.

The species probably occurs not only along the Rio Grande, but also along its tributary streams, both in Texas and in the Mexican states of Coahuila, Nuevo Leon and Tamaulipas, wherever the soil conditions are suitable.

In March, 1907, Mr. F. B. Headley visited the Rio Grande Valley near the mouth of the Pecos River and sent specimens and photographs, adding the following notes on the species:

"A characteristic of . . . this species is that as fast as the old trunks die out new ones shoot forth from the same base. The majority of the trees observed were staminate. More trees are found growing in rocky than in silt soil. It may be that the pistache is crowded out from those soils and locations where it enters into competition with other trees. It is evidently highly drought-resistant, for it grows out of rocky soils at an altitude of from 200 to 300 feet above the river level. It also grows in moist locations, but most of the trees observed and photographed were growing out of the rock bottom of cañons which are periodically swept by floods. I found many trees having neither staminate nor pistillate blossoms. Goats seem to be fond of the leaves and it is probably for this reason that there are at present no young pistaches in this location." ¹

Prof. S. C. Mason's notes on an unusually large tree read as follows:

"Along the pond below the Hinojose spring I located what I believed to be the largest pistache tree yet recorded. . . . This was in a rich . . . alluvium and its roots doubtless penetrate to permanent moisture. The main old trunk is fourteen inches in diameter, besides several large sprouts from the ground seven or eight inches in diameter, others smaller; the entire tree having a spread of thirty-nine feet and a height of about thirty feet." ²

On the second trip by Professor Mason, April 7, 1910, this tree was found to be staminate and already out of bloom; but on his third trip, March 17, 1911, this tree was in full bloom and from it the male syntype was collected as well as many additional specimens (merotypes).

The larger trees in the alluvial plain of the Rio Grande near the mouth of the Pecos River are nearly all male. Professor Mason, who visited this region in March, and again in April, 1910, expressly to study this Pistache, reports as follows:

"On Saturday morning . . . I made a tramp alone of twelve or fifteen miles, going to the big bend of the Rio Grande six miles above our camp [near the Big Spring on Hinojose's ranch]. Just below this I discovered two large groves of pistache in the old alluvium at the front of the bluffs facing the river. . . . In all of these groups the pistillate trees were in very small proportion, not over ten per cent. This is a difficult matter to offer an explanation for. Another point may be merely accidental, but without exception the large trees are staminate. In no case did we find an unusually large tree to be pistillate. . . .

The recuperative power of this tree is remarkable. Parts of a stool that are old and dead at the top will send up most vigorous shoots, so that the top is renewed and kept vigorous. The growth is slow, a stem of apparently average growth, $4\frac{1}{2}$ inches in diameter, showing 33 annual rings. This stick shows on a radial measurement, $1\frac{1}{4}$ inches of yellow-brown heart wood to one inch of sap wood. The sap wood is

¹ Frank B. Headley, letter to Walter T. Swingle, dated San Antonio, Texas, April 1, 1907.

² Letter to Walter T. Swingle dated San Antonio, Texas, March 7, 1910.

nearly white with a pale yellowish cast. Both sap and heart wood show small, fine, medullary rays. The wood is rather tough, strong, compact, fine-grained, and weighs approximately 60 pounds to the cubic foot. It shows only a moderate tendency to check in seasoning and little inclination to warp. The wood could only be procured in short and small samples, seldom more than three or four feet long, and from six to eight inches in diameter, but for small articles, as in turnery, and possibly for blocks for wood engraving, it has valuable qualities.

It is a thin-foliaged species, highly intolerant of shade, cleaning up its stem and small branches very rapidly."¹

The true *Pistacia mexicana* is a tree having a single well-marked trunk, not branched at or near the surface of the ground. This is shown clearly by photographs taken near Tehuecan, Puebla, by Dr. J. N. Rose and Mr. C. A. Purpus, and now filed in the National Herbarium, and by a photograph taken in the same region by Dr. D. T. MacDougal, now filed in the herbarium of the New York Botanical Garden. The Texas Pistache, on the contrary, almost never develops a single trunk. Prof. S. C. Mason says of the individuals of this species:

"All show a strong tendency to produce several trunks from the ground or to sprout low down, rather than to form a single stem. In the thickets in the rich soil along the river front (the alluvium of an ancient river flood plain, high above the present) these divergent stems are so highly curved and interlocked as to make the groups almost impenetrable. There is no sign of sprouting from the roots, or what may be termed suckering, nor any indication of surface roots. Deep penetration of the roots seems to be the rule."¹

The smaller branches of *P. mexicana* are smooth and light brownish gray, while *P. texana* has rather rough, dark brownish gray branches, never silvery.

POSSIBLE ECONOMIC USES: At first I feared the American Pistaches were so different from the old-world species that the Pistache-nut tree (*Pistacia vera* L.) could not be grafted on them. However, it has been found by Mr. Eugene May, Jr., that the Pistache-nut tree can be budded readily on *P. mexicana*, and in view of the close affinity of the Texas species it is highly probable that it also can be used as a stock on which to grow the true Pistache-nut.

The Texas Pistache as it grows in the limestone country near the mouth of the Pecos, forms compact, rounded clumps, with dark, evergreen foliage. In early spring the new growth shows a beautiful wine-red color all over the clump. It is a handsome tree, well worthy of trial as an ornamental, especially in warmer parts of the southwestern United States.

BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.
September 18, 1920

¹ Letter to Walter T. Swingle, from San Antonio, Texas, April 15, 1910.

A NEW SPECIES OF CAMPNOSPERMA FROM PANAMA

PAUL C. STANDLEY¹

COLLECTIONS of plants obtained in Panama in recent years have revealed the occurrence in that region of many genera of plants, especially of trees, which previously were believed to be confined to the forests of Brazil and the adjoining countries. It is now evident that the Panamanian flora is much more closely allied with that of Brazil than has been believed heretofore. Another striking example of this relationship is afforded by the new species of *Campnosperma* here described. This genus, which is a member of the Anacardiaceae, has been known in America from a single species, *Campnosperma gummifera* (Benth.) L. March., a native of the Amazon region of Brazil. The other members of the group are natives of the East Indies.

Campnosperma panamensis Standley, sp. nov.

Ramulis 12 mm. crassis, cortice rugoso obtectis, novellis stellato-puberulis, dense foliatis; foliis breviter petiolatis, oblongo-obovatis, 27 cm. longis, 11.5 cm. latis, apice rotundatis, basi cuneatis, coriaceis, supra glabris, subtus dense stellato-lepidotis, costa supra canaliculata, subtus valde prominente, nervis lateralibus subparallelis, utrinque latere circiter 20, sub margine adscendentibus; paniculis interrupte spiciformibus, longe pedunculatis, 13-18 cm. longis, stellato-puberulis, floribus pedicellis perbrevibus crassis fultis; calycis lobis ovato-rotundatis, 1.5 mm. longis, stellato-puberulis, obtusis; petalis triangulari-ovatis, acutiusculis, costa extus stellato-puberula; staminibus petalis brevioribus, filamentis glabris; disco crasso, 1 mm. alto, 2-2.5 mm. lato; fructu juvenili ovoideo, lepidoto.

Type in the herbarium of the Arnold Arboretum, collected "at the Chiriquito Lagoon on the south side of Panama where it covers an area of about 6 square miles" and received from A. D. Little, Inc., of Cambridge, Massachusetts, in August, 1920.

The specimen was forwarded to the writer by Mr. Alfred Rehder, who had already referred it to the Anacardiaceae.

No specimens of the Brazilian *C. gummifera* have been seen by the writer, but an excellent plate of that species is given by Engler in Martius's *Flora Brasiliensis* (xii.² t. 82 [1876]). The Panamanian plant agrees very well with the plate, except in its longer panicles. Engler, however, describes the leaves, sepals, and fruit as glabrous, and in his later monograph of the Anacardiaceae² he uses the presence or absence of pubescence upon the leaves as a key character, placing *C. gummifera* among the species with glabrous leaves. The only species of *Campnosperma* described as having pubescent leaves is *C. macrophylla* (Blume) Hook. f., an East Indian tree. In that, however, the pubescence is stellate and comparatively coarse, while the pu-

¹ Published by permission of the Secretary of the Smithsonian Institution.

² In De Candolle, *Monog. Phan.* iv. 316-321 (1883).

bescence in *C. panamensis* is essentially lepidote, each trichome having a conspicuous, flat, brown centre. One of the panicles of the type specimen of *C. panamensis* bears two bractlike leaves about 2 cm. long at the apex of the peduncle.

U.S. NATIONAL MUSEUM
WASHINGTON, D.C.
September 21, 1920

NOTES ON NORTH AMERICAN TREES. VII¹

C. S. SARGENT

Prunus

THE last ten years have added little to our knowledge of the Plum-trees of North America, where in the Arkansas, Oklahoma and Texas region they are more numerous in species and probably in individuals than in any other part of the world. It is difficult to obtain good material for a complete study of these trees. They flower early when there is little else in bloom to occupy the collector, who is obliged to make long and expensive journeys to collect the flowers of one genus. In four years out of five the young fruit is destroyed by the severe frosts which in that region usually come later than the flowering of the Plum-trees. When the fruit escapes destruction by frost it is difficult to obtain, for it ripens at the season when heat and insects make plant collecting in the region where plums abound a difficult and disagreeable undertaking. The different specimens are often widely separated, and it is therefore impossible to make the comparative study of the living plants which is necessary in order properly to understand their similarities and differences. That there are natural hybrids between at least some of the shrubby species is probable, but it has not yet been possible with available material to work these out; and there is little prospect that American Plums can be properly understood until all or most of the species can be grown together in one garden until they flower and produce fruit. Such a collection will not be easy to establish and maintain, for some of the most interesting species are not hardy in the north, and, except in the north, it is not probable that such a collection will be attempted. A good beginning of such a collection has been made by the Park Department of the City of Rochester, New York, which has brought from Oklahoma and Texas a large number of living plants of several species, varieties and probable hybrids, and many seedlings have been raised from the fruit which has ripened in Rochester on these plants. There are, too, a number of American Plums in the Arnold Arboretum, although some of the Texas and Oklahoma species which are doing well in Rochester have not proved entirely hardy here.

Prunus americana Marsh. is usually described as spreading by suckers from the roots into large or small thickets. In the north this seems to be

¹ For part vi, see Vol. I, p. 245.

generally true, but in western Florida, in the neighborhood of Selma, Dallas County, Alabama, and of Starkville and Jackson, Mississippi, and near New Orleans, Louisiana, trees which I cannot otherwise distinguish from *Prunus americana* grow with a single stem and show no tendency to produce plants from the roots. When better known it is possible that these trees may prove distinct enough from the northern tree to make it possible to consider them specifically distinct. Unfortunately seedlings of the Florida and Alabama trees raised at the Arboretum have not proved hardy, and it will not be possible to give them here the sustained observations necessary for the proper understanding of any species of Plum-tree. One of the Florida Plum-trees, however, seems distinct enough to be considered a variety, for which I suggest the name of

Prunus americana var. *floridana*, n. var.

Differing from the type in its thinner finely serrate leaves and purple fruit.

Leaves oval to slightly obovate or rarely ovate, usually abruptly short-pointed, acute or acuminate at apex, gradually narrowed and cuneate or rounded at base, and finely often doubly serrate with short apiculate teeth, when they unfold tinged with red and slightly pubescent, and at maturity thin, dull dark green on the upper surface, paler on the lower surface, 6-8 cm. long and 3.5-5 cm. wide, with a slender midrib and primary veins sparingly villose on the lower side; petioles slender, pubescent or puberulous, eglandular, 7-12 mm. in length; stipules linear, puberulous, 6 or 7 mm. long, caducous. Flowers opening from the middle to the end of March, 2 cm. in diameter, on slender glabrous pedicels tinged with red and 1.7-2 cm. in length, in 2- or 3-flowered short-stalked umbels; calyx glabrous, red, the lobes narrow-acuminate, entire or glandular serrate toward the apex and usually ciliate on the margins, puberulous on the outer surface, villose-pubescent on the inner surface; petals oblong-obovate, rounded at apex, contracted below into a narrow claw, 7 or 8 mm. wide; filaments glabrous, longer than the petals; ovary and style glabrous. Fruit short-oblong, rounded at ends, 2.5 cm. long and 2-2.2 cm. in diameter, red becoming purple when fully ripe, with a thin skin, thick sweet flesh and an oblong flattened stone pointed at ends, acutely ridged on the ventral suture, obscurely grooved on the dorsal suture, 1.7-1.8 cm. long, 1.3-1.4 cm. wide, and 7 or 8 mm. thick.

A small tree without suckers from the roots, with pale gray bark and slender glabrous red-brown branchlets.

FLORIDA. Low rich woods in the neighborhood of St. Marks, Wakulia County, common; *T. G. Harbison* (No. 30 = 1427, type), March 30, 1914, September 17, 1919; No. 1207, September 25, 1913.

Prunus mexicana S. Wats. The common "Big-tree" Plum of Texas which I described as *Prunus arkansana* (*Trees and Shrubs*, II. 157, t. 165 [1911]) has been probably correctly referred to Sereno Watson's *P. mexicana* (in *Proc. Am. Acad.* xvii. 352 [1882]), based on a fragmentary speci-

men collected by Dr. Edward Palmer at Lerios, Coahuila. The Big-tree Plum has thick leaves usually broad and rounded at base with more or less prominent reticulate veinlets, villose-pubescent on the midrib and veins below, glabrous pedicels and globose or rarely short-oblong dark red fruit covered with a bluish bloom, the stone nearly round to obovoid, turgid, usually pointed at base and rounded at apex.

Prunus mexicana, which is distributed through Arkansas to southeastern Kansas, eastern Oklahoma, western Louisiana, and eastern and southeastern Texas into northwestern Mexico, and occurs in eastern Louisiana, never produces suckers from the roots, and is a tree up to 14 m. in height with a single trunk often 3 dm. in diameter, covered with dark, nearly black or light gray bark, exfoliating in plate-like scales on young stems and large branches, and becoming rough and furrowed on old trunks. With more knowledge of the Big-tree Plum than I had when I described it in 1911 it seems better to consider varieties of *P. mexicana* the related species which I described at that time as *P. reticulata*, *P. polyandra* and *P. fultonensis*. These three then become:

Prunus mexicana var. *reticulata*, n. var. — *Prunus reticulata* Sargent in *Trees and Shrubs*, II. 151, t. 162 (1911).

Differing from the type in its thicker leaves more often narrowed at base, with more prominent reticulate veinlets, pubescent pedicels, smaller globose fruit ripening late in September or in October, with thin bitter astringent flesh, and dark deeply furrowed bark.

DISTRIBUTION. Uplands and along the margins of river-bottom lands; in the neighborhood of Dallas and of Sherman, Grayson County, northern Texas.

Prunus mexicana var. *polyandra*, n. var. — *Prunus polyandra* Sargent in *Trees and Shrubs*, II. 155, t. 164 (1911).

Differing from the type in the narrower base of the leaves, the more numerous stamens (up to 36), in its earlier ripening fruit with an obovoid compressed stone pointed at apex, and gradually narrowed and acute at base.

DISTRIBUTION. Rich woods, Fulton, Hempstead County, Arkansas.

Prunus mexicana var. *fultonensis*, n. var. — *Prunus fultonensis* Sargent in *Trees and Shrubs*, II. 248 (1913).

Differing from the type in its thinner leaves pubescent below over the whole surface, with more obscure reticulate veinlets, and in its smaller dark bluish purple fruit ripening in June, with thin flesh and a compressed stone pointed at apex and gradually narrowed and acute at base.

DISTRIBUTION. Rich woods near Fulton, Hempstead County, Arkansas.

Prunus virginiana L. Attempts have been made by different authors to separate the Choke Cherry of North America into several species, but a careful examination of the large amount of material preserved in the herbarium of the Arboretum and a study of the trees growing in a considerable part of the region which the Choke Cherry inhabits and in cultivation fails to show characters in the different forms sufficiently stable to justify their

treatment as species. In all the forms the leaves are oval, oblong or obovate, abruptly pointed, sharply sometimes doubly serrate with slender spreading teeth, and green or pale on the lower surface. The flowers and the fruits of all the forms vary considerably in size, and in the west the fruit is often less astringent and is usually darker in color at maturity than in the east. If the different forms are considered varieties they may be arranged as follows:

Prunus virginiana L. Leaves cuneate or rounded or rarely slightly cordate at base, pale or green on the lower surface, glabrous or furnished below with axillary tufts of short hairs, and very rarely villose on the lower side of the midrib. Fruit red at first when fully grown, becoming at maturity bright red, dark crimson or nearly black, more or less astringent at maturity; in one form (var. *leucocarpa* S. Wats.) bright canary yellow.

Usually a small or large shrub; occasionally truly arborescent, especially the yellow-fruited variety, and from six to eight meters high.

The typical *Prunus virginiana* is distributed from Newfoundland to Labrador and the shores of Hudson Bay, and southward to the valley of the Potomac River, to Buncombe and Tridell Counties, North Carolina (*Cerasus virginiana* β *humilior* Michx.), and to northern Kentucky, and westward to Saskatchewan, and in the United States to eastern North Dakota, eastern Nebraska, northeastern Missouri and northeastern Kansas.

Prunus virginiana var. *demissa* Torr. This most distinct of the varieties of the Choke Cherry was discovered by Nuttall in western Oregon and was called by him *Cerasus demissa*. The leaves of this tree, which are usually cordate at the base and covered below with pale pubescence, certainly appear distinct from those of the eastern plant, but trees with leaves cuneate or rounded at base are also common in the Pacific coast region, leaves with a cordate and with a cuneate base often occurring on the same branch, and there is nothing but the pubescence of their lower surface by which this western tree can be distinguished from the eastern tree. *Prunus virginiana* var. *demissa*, which I know in the Pacific States only in western Washington and Oregon, and in Kern and Napa Counties, California, is not confined to the Pacific States if the pubescence on the lower surface of the leaves can be depended on to distinguish it. Fendler's New Mexican specimen (No. 1847 in Herb. Gray) has cordate leaves pubescent below. On a specimen collected by Professor Pammel near Ames, Iowa, in July, 1914, the leaves are cuneate, rounded or slightly cordate at base and pubescent on the lower surface. A specimen (No. 112) collected by V. H. Chase near Wady Petra, Stark County, Illinois, has the broad leaves rounded or subcordate at base of var. *demissa* although only slightly pubescent below; and the leaves of two specimens (Nos. 6643 and 13058) collected by C. C. Deam in LaPorte County, Indiana, are rounded or cuneate at base and slightly pubescent below, and with the Wady Petra specimen seem to connect the trees of the Atlantic and Pacific coast regions. More distinct with its pubescent branchlets is:

Prunus virginiana var. *demissa* f. *pachyrrhachis*, n. comb. — *Prunus demissa* var. *Nuttallii* f. *pachyrrhachis* Koehne in Mitt. Deutsch. Dendr. Gesell. xx. 236 (1911). — *Padus valida* Wooton & Standley in Contrib. U.S. Nat. Herb. xvi. 134 (1913).

Differing from var. *demissa* in the cuneate or rounded base of the leaves villose pubescent below on the midrib and veins, in the stouter pubescent rachis and pedicels, and in the pubescent branchlets usually becoming glabrous at the end of their first season.

Leaves oval or slightly obovate, acute or abruptly short-pointed at apex, rounded at base, finely serrate, thick, dark green and glabrous above, pale and villose below along the midrib and principal veins, 5–7 cm. long and 2.5–3.5 cm. wide; petioles stout, pubescent, glandular at apex, 1–1.5 cm. in length; leaves of a vigorous shoot 10–11 cm. long and 5–6 cm. wide. Flowers not seen. Mature rachis and pedicels stout, densely pubescent. Probably a shrub with usually stout branchlets finely pubescent during their first and second seasons, and stout acute winter-buds 8 mm. or 9 mm. long.

TYPE LOCALITY. Canyons, Kingston, Sierra County, New Mexico, at an altitude of 2200 m., August 24, 1904, O. B. Metcalfe (No. 1243 in Herb. Nat. Mus.).

The type of this form is well distinguished by its stout pubescent branchlets, large winter-buds, thick pubescent rachis and pubescent pedicels. Flowers of the type have not been seen, but the fruit and its stone are similar to those of *Prunus virginiana*. The other Choke Cherries from New Mexico, *Padus pumicea*, *P. calophylla* and *P. mescaleria* Wooton & Standley (in Contrib. U.S. Nat. Herb. xvi. 133, 134 [1913]), varying somewhat in the shape of their leaves and in the amount of their pubescence, have branchlets more or less pubescent and afford no characters by which they can be satisfactorily separated. The type specimen of *Padus pumicea* (No. 563903 in Herb. Nat. Mus.) is a sterile branch with slightly pubescent leaves and branchlets. Another specimen (No. 737183 in Herb. Nat. Mus.) referred to this species from the same locality has more pubescent leaves and branchlets and a slender pubescent rachis, and so resembles forma *pachyrrhachis*. The type specimen of *Padus calophylla* (No. 562677 in Herb. Nat. Mus.) has narrow-elliptic pubescent leaves, a slender puberulous rachis and branchlets; another specimen referred to this species (No. 686679 in Herb. Nat. Mus.) has broad-oval leaves glabrous with the exception of small axillary tufts of pale hairs below, and a slender puberulous rachis and branchlets. The type specimen of *Padus mescaleria* (No. 690233 in Herb. Nat. Mus.) has slightly pubescent leaves, a glabrous rachis and puberulous branchlets. Although perhaps most closely related to the form *pachyrrhachis*, the specimens of these three species in their slender branchlets show a transition to *Prunus virginiana* var. *melanocarpa*. Their connection with *P. virginiana* var. *demissa* is shown by a sterile specimen (No. 6042 in Herb. Arnold Arboretum) collected near Valentine, Cherry County, in northern Nebraska by the Reverend John Bates, with broad-oval or obovate leaves pubescent below and distinctly pubescent branchlets, and by a specimen

(in Herb. Arnold Arboretum) collected by C. L. Anderson near Santa Cruz, California, with narrow pubescent leaves, a glabrous rachis and puberulous branchlets, and referred by Koehne to his *P. demissa* var. *Nuttallii* f. *holotricha*.

Prunus virginiana var. *melanocarpa*, nov. comb. — *Cerasus demissa* var. *melanocarpa* A. Nelson in Bot. Gaz. xxxiv. 25 (1902). *Prunus melanocarpa* Rydberg in Bull. Torr. Bot. Club, xxxiii. 143 (1906).

This is the widely distributed Rocky Mountain form of the Choke Cherry, differing from the eastern typical form in its rather thicker leaves and usually darker fruit sometimes black or nearly black at maturity. This is a common usually shrubby plant often only 2° or 3° high, or occasionally a tree, distributed from western North and South Dakota and Nebraska to southern Colorado, New Mexico and southern Arizona to the Pacific coast where it ranges from British Columbia to San Diego County, California. In North Dakota the eastern and western forms "intergrade so completely that there is no way of distinguishing them except in extreme cases. The difference is apparently due to the conditions under which they grow, so that they are to be considered merely as forms of the same species."¹

A form with yellow fruit may be distinguished as forma *xanthocarpa*, n. forma. Near La Veta, Huerfano County, Colorado, C. S. Sargent, August, 1911.

Prunus virens Shreve.

This New Mexican and Arizona Cherry-tree, although very closely related to *Prunus serotina* Ehrhart, may be distinguished from that species by its smaller more finely serrate glabrous usually elliptic or oval to rarely oblong-obovate or ovate leaves acute or rounded, rarely acuminate, at apex and cuneate at base, by its eglandular petioles, by its shorter racemes and smaller flowers. In the typical form the leaves are glabrous, but on some trees the under side of the midrib of the leaves is furnished on the margins below the middle with a thick coat of rusty pubescence showing the connection of these trees with

Prunus virens var. *rufula*, n. var. — *Padus rufula* Wooton & Standley in Contrib. U.S. Nat. Herb. xvi. 132 (1913).

Differing from the type in the rusty brown persistent pubescence on the under side of the midrib of the leaves, the pubescent petioles, the pubescence on the lower part of the rachis, the puberulous ovary, and in the rusty brown pubescence of the young branchlets.

The type of *Padus rufula* (No. 563998 in U.S. Nat. Herb.) collected on the west fork of the Gila River, Arizona, August, 1900, has leaves only 4-4.5 cm. in length and branchlets thickly covered with matted rusty hairs. The specimens in the National Herbarium referred to *Padus rufula* vary in the amount of the pubescence on the branchlets, and those of No. 497841

¹ H. F. Bergman, Fl. North Dakota in Sixth Biennial Rep. North Dakota Soil and Geological Survey, 207 (1912).

collected in flower in 1904 on the Black Range, New Mexico, by O. B. Metcalfe are nearly glabrous.

DISTRIBUTION. With the species on many of the mountain ranges of southern New Mexico and Arizona usually at altitudes between 1800 and 2000 m.

The oldest specimens of this variety which I have seen were collected by J. G. Lemmon on the Chiricahua Mountains, Arizona, May, 1881. "Tree 40° high" (No. 156 in Herb. Gray), by Pringle in "rich cañons" of the Santa Rita Mountains, Arizona, in July, 1881, and by Rusby (No. 2159) on the Mogollon Mountains, New Mexico, in August, 1881.

Aesculus

Aesculus glabra Willd. The leaves of the type of this tree as described by Willdenow (Enum. Pl. 405 [1809]) are "glaberrima." The type was a tree cultivated at Berlin, and wild trees with entirely glabrous leaves occur, but appear to be extremely rare, and are found chiefly in the region east of the Mississippi River. Usually the leaflets are furnished below with conspicuous tufts of axillary hairs, and westward their lower surface is often covered in early spring with loose, floccose hairs which are most abundant on the midrib and veins, and usually disappear before the beginning of the summer. More distinct is a form with leaflets thickly covered below with close, dense pubescence, persistent during this season. What is evidently this form was described as *Aesculus pallida* by Willdenow (l. c. 406) who says of it "Folia subtus pubescentia et ut in *A. Pavia* atque *flava* in axillis venarum fasciculo pilorum instructa, quum praecedentis [*A. glabra*] folia semper glaberrima sint." This form, although it differs from the type only in the pubescence of the leaves and young branchlets, is probably best considered a variety, especially as it is found only in a comparatively restricted area. Treated as such it becomes:

Aesculus glabra var. *pallida* Kirchner in Petzold and Kirchner, Arb. Musc. 166 (1864).

The only specimens of this variety which I have seen are the following:

IOWA. Indianola, Warren County, and Moringona, Boone County, *L. H. Pammel*, August and September, 1912.

MISSOURI. Hannibal, Marion County, *J. Davis* (No. 2136), September, 1913; Galena, Stone County, *E. J. Palmer* (No. 5706) May, 1914; Eagle Rock, Barry County, *E. J. Palmer* (No. 6286) July, 1914.

ARKANSAS. Winslow, Washington County, *E. J. Palmer* (No. 8263) July, 1915.

It is interesting that the variety of *A. glabra* with usually seven leaflets (var. *Buckleyi* Sarg.) from Jackson County, Missouri, the type locality, is pubescent, that a specimen of this variety from eastern Kansas is nearly glabrous and that specimens from Ohio and Mississippi are glabrous.

Aesculus octandra Marsh. As long ago as 1856 Asa Gray in the third edition of his Manual described a var. *purpurascens* of this species. He referred to his variety *Aesculus discolor* of Pursh as a synonym and gave the range from W. Virginia southward and westward. The flowers (both

calyx and corolla) were described as tinged with flesh color or deep purple and the leaflets as commonly downy below. This description was probably based on specimens of *Aesculus discolor* of Pursh, for Gray had no specimen of a red-flowered *Aesculus octandra* in his herbarium. The confusion about a red-flowered Appalachian Buckeye was increased in the second volume of the *Silva* of North America in which I proposed the name *Aesculus octandra* var. *hybrida* for a tree said to be not rare on the Appalachian Mountains. The description, however, was that of *Aesculus discolor*, and *Aesculus hybrida* DC; a hybrid between *Aesculus octandra* and *A. Pavia* which appeared in Europe more than a century ago, was thought to be the Appalachian tree. Who started the story that a red-flowered Buckeye grew on the Mountains of Virginia, I do not know. For many years I have been looking for it in the field and in herbaria. I thought I had found it at Mount Vernon among the trees which Washington planted about 1785 and which were believed to have been raised from seeds which he had gathered near the mouth of Cheate River, West Virginia. I am now satisfied that these trees are hybrids between *Aesculus Pavia* or *Aesculus discolor* and some species with petals ciliate on the margins. They could not have come from seeds gathered in West Virginia. *Aesculus discolor* and *A. Pavia* do not, so far as I know, grow in West Virginia and *A. octandra* does not grow in any part of the country near *Aesculus Pavia* or *A. discolor*. *Aesculus discolor* does, however, grow with or near *Aesculus georgiana* in northern Georgia and it is possible that the elder Michaux or John Bartram whom Washington consulted about his trees may have given him nuts brought from South Carolina or Georgia which produced the Mount Vernon trees. This theory is possible, but hardly probable; and the Mount Vernon Buckeyes present a problem which I am unable to solve. That they are hybrids the mixture of hairs and glands on the margin of the petals seems to show.

That the story, whoever may have started it, of a red-flowered form of *Aesculus octandra* on the mountains of West Virginia is true is now shown by specimens in this herbarium collected on May 17, 1919, in the neighborhood of White Sulphur Springs, Greenbriar County, by Mr. John S. Ames, who went specially to West Virginia to look for this tree. He was fortunate in finding several trees with red flowers and others with pink and cream-colored flowers growing with the typical yellow-flowered trees. This red-flowered form of *Aesculus octandra* is without a name, for the var. *purpurascens* Gray is *Aesculus discolor* Pursh by description and synonymy and the var. *hybrida* Sarg. is a confusion of the hybrid *Aesculus hybrida* DC. and *Aesculus discolor* Pursh. and I suggest that it be called

***Aesculus octandra* var. *virginica*, n. var.**

Differing from the type only in the red, pink or cream-colored flowers.

***Aesculus georgiana* Sarg.** The type of this species was found in the neighborhood of Stone Mountain, DeKalb County, Georgia, where it is common as a broad shrub from 1-2 m. high. The flowers which are produced in short, compact clusters, have a red and yellow calyx and red pet-

als ciliate on the margin. This species which is easily distinguished from *Aesculus octandra* by the absence of glandular hairs on the calyx and pedicel is now known to be widely distributed in the Piedmont regions from North Carolina to northern Georgia, and to occur on the banks of the Savannah River near Augusta, Richmond County, Georgia, in northern Alabama (Madison, Etowah and Tuscaloosa Counties) and near Pensacola, Escambia County, Florida. It is sometimes a shrub but often a slender tree from 10 to 15 m. high. The flowers are sometimes red and yellow, often yellow and occasionally bright red. The inflorescence which is short, broad and densely flowered in the type, is sometimes narrow and more elongated with less crowded flowers. The calyx which is normally campanulate varies considerably in shape and is occasionally tubular, the two forms sometimes appearing in the same inflorescence. The var. *pubescens* Sarg. distinguished by the pubescence on the lower surface of the leaves, known first only from the neighborhood of Stone Mountain proves also to be widely distributed and occasionally arborescent in habit. This variety is common in the woods west of Augusta and occurs in Rabun and Floyd Counties, Georgia; in North Carolina it ascends on the Blue Ridge to altitudes of about 1000 meters and ranges northward in the Piedmont region to Orange County; southward it is not rare with the species in northern Alabama. A form with narrow leaflets may be distinguished as

Aesculus georgiana var. *lanceolata*, n. var.

Differing from the type in its narrow-lanceolate or slightly oblanceolate leaflets.

Leaves 5-foliolate with glabrous petioles 9-12 cm. in length; leaflets lanceolate to slightly oblanceolate long-acuminate at apex cuneate at base, finely serrate with incurved gland-tipped teeth, when the flowers open early in May thin, yellow-green above, pale below, glabrous with the exception of occasional hairs on the under side of the slender midrib and of minute axillary tufts, 13-18 cm. long and 3-4 cm. wide, their petiolules 5-8 mm. in length. Flowers bright red, otherwise as in the type, in a narrow panicle 15 cm. in length. Fruit not seen.

A tree 8-10 m. high with a short trunk 15-20 cm. in diameter, erect branches forming a narrow head and slender, glabrous branchlets.

GEORGIA. Rabun County, T. G. Harbison (No. 19 type) May 9, 1917.

× *Aesculus Bushii* Schneid. (*A. discolor* var. *mollis* Sarg. × *A. glabra* var. *leucodermis* Sarg.)

To this hybrid which was found several years ago near Fulton, Hempstead County, Arkansas, should probably be referred a tree found near Starkville, Oktibbeha County, Mississippi, by T. G. Harbison (No. 1055) April 7, 1913. From the type of *A. Bushii* the Mississippi tree differs in its rather more pubescent and less coarsely serrate leaflets, in its longer and narrower inflorescence, and in its narrower red calyx and darker red petals.

Aesculus discolor var. *mollis*, *A. Pavia* and the typical form of *A. glabra* are the only Buckeyes which grow in Oktibbeha County. The mixture of

hairs and glands on the margin of the petals indicate the hybrid origin of the Harbison plants and the pubescent under surface of its leaflets point to *A. discolor* var. *mollis* rather than to *A. Pavia* as one of the parents of this hybrid.

× *Aesculus mississippiensis* (*A. glabra* × *A. Pavia*), n. hybr.

Leaves 5-foliolate with petioles slightly pubescent toward the apex on the upper side and 8-10 cm. in length; leaflets elliptic to oblong-obovate, acuminate and often abruptly pointed at apex cuneate or rounded and often unsymmetric at base, finely often doubly serrate with incurved gland-tipped teeth, glabrous with the exception of short hairs scattered on the upper side of the lower part of the midrib and of small tufts of axillary hairs, 9-10 cm. long, 4-5 cm. wide, and sessile or raised on a short pubescent petiolule. Flowers appearing early in April in puberulous panicles 8-10 cm. in length on slender slightly pubescent pedicels, 6-8 mm. long; calyx narrow-campanulate, red, glabrous, the lobes ciliate on the margin; petals dark red or yellow, pubescent furnished on the margin with hairs and glands. Fruit slightly and irregularly tuberculate; seed 2-3 cm. in diameter, dark chestnut-brown with a small hilum.

A tree 6 to 7 m. high with a trunk 16 cm. in diameter and slender glabrous branchlets.

MISSISSIPPI. Low woods; near Brookville, Noxubee County, *T. G. Harbison* (Nos. 1061, type and 1061 A), April 8, and October, 1913.

The mixture of hairs and glands on the margin of the petals of this tree indicate that it is a hybrid of a species of the subsection *Octandrae* with one of the *Eupaviae*. Of the former subsection only *A. glabra* grows in southern Mississippi where both *A. Pavia* and *A. discolor* var. *mollis*, of the *Eupaviae* are common; and the general absence of pubescence from the leaflets of the hybrid point to *A. Pavia* as its other parent. Two specimens collected at Starkville, Oktibbeha County, Mississippi, by *T. G. Harbison* (Nos. 1054 and 1056) April 7, 1913, with rather larger flowers, probably represent the same hybrid.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM ¹

ALFRED REHDER

ROSACEAE (*continued*)

Prunus L.

× *Prunus arnoldiana*, hybr. nov. (*P. cerasifera* × *triloba*).

Frutex 2-metralis v. ultra, ramosissimus, satis densus, ramis patentibus divaricatis; ramuli annotini glabri, plerumque virides, annotini fuscorubri; gemmae ovatae, parvae, pleraeque stipulis paucis praeditae. Folia

¹ Continued from p. 62.

elliptica vel ovato-elliptica vel inferiora interdum obovata acuta, basi cuneata, 3-6 cm. longa et 1.7-3 cm. lata, crenato-serrata dentibus late ovatis abrupte acuminulatis, interdum leviter dupliciter serrata, supra sparse adpresse pilosula, subtus sparse, ad nervos densius villosa, utrinsecus nervis 5-8; petioli 0.4-1 cm. longi, sparse villosi, apice plerumque glandulis 1-3 instructi; stipulae subulatae, glanduloso-serrulatae, basi lobulis 1-2 instructae. Flores solitarii, coetanei, albi, in alabastro colore roseo suffusi, fere 2.5 cm. diam.; pedicelli circiter 5 mm. longi, glabri; calyx late campanulatus, extus glaber, intus supra medium villosulus; sepala ovalia, obtusa, serrulata, extus glabra, intus villosula, sub anthesi reflexa, tubum fere aequantia; petala ovalia, 11-13 mm. longa; stamina circiter 30, petalis breviora; ovarium villosum; stylus staminibus paullo brevior. Fructus subglobosus, ruber, sparsissime villosus; putamen globoso-ovoideum, 12 mm. longum et 11 mm. latum, compressum, carinatum, leviter punctatogulosum.

Cultivated at the Arnold Arboretum sub no. 3176-5 (raised from seed of *P. triloba* in 1902); specimen collected May 9, 1914, Aug. 14, 1915 (fruit), May 23, 1917, May 3, 1919, September 11, 1920.

This hybrid originated in 1902 at the Arnold Arboretum from seed of a plant of *P. triloba* derived in the second generation from seed sent by Dr. Bretschneider in 1884 from the mountains near Peking. It differs from *P. triloba* chiefly in the white flowers coming out with the first young leaves, the longer pedicels, the reflexed calyx-lobes pubescent inside, in the stamens exceeding the style, the generally elliptic, less coarsely and scarcely doubly serrate leaves, in the longer petioles, the larger more succulent and less hairy fruit with a more compressed sharply keeled stone, and in the shorter stipules of the winter-buds. From *P. cerasifera* Ehrh. which blossoms at about the same time and is apparently the other parent, it differs in the red-brown color of the one year old branchlets, in the shorter pedicels, the villous ovary, the larger and broader sometimes obovate and more pubescent leaves with coarser more acute teeth and in the slightly hairy fruit with a more globose stone. It is interesting as being a hybrid between species of the subgenera *Amygdalus* and *Prunophora*, and is to my knowledge the first known hybrid between these two subgenera.

Prunus arnoldiana is a handsome freely and early flowering shrub of rather dense habit. From *P. cerasifera* it differs in its more compact shrubby habit and from *P. triloba* in its more numerous white flowers.

Prunus Meyeri, sp. vel hybr. nov. (? *P. Maackii* × *Maximowiczii*.)

Arbor pyramidalis ramis patentibus, ramulis junioribus puberulis, annuinis purpureo-fuscis, ramis vetustioribus aurantiaco-brunneis lucidis laevibus lenticellis magnis horizontalibus notatis, cortice trunci brunneo longitudinaliter fisso; gemmae ovoideo-conicae, brunneae, glabrae, pauci-perulatae. Folia ovata v. elliptico-ovata ad ovato-oblonga, acuminata, basi pleraque¹ rotundata, 4-8 cm. longa et 3-5 cm. lata, eaturionum pleraque oblongo-ovata et ad 14 cm. longa et fere ad 6 m. lata, dupliciter ad subsimiliciter serrata dentibus triangulari-ovatis acutis, supra glabra, laete

viridia, subtus ad costa densius, ad nervos sparsius pilosa, ceterum glabra, sed glandulis fuscis conspersa; petioli pubescentes, 1–1.5 cm. longi. Racemi multiflori, pedunculo bracteis foliaceis instructo incluso 5–6 cm. longi, pubescentes; pedicelli sparse pubescentes, inferiores 0.6–1 cm. longi, apicem versus decrescentes, bracteis dimidium pedicellum plerisque superantibus lanceolatis v. lineari-lanceolatis glanduloso-denticulatis inferioribus saepe latioribus et foliaceis suffulti; calyx extus sparse pilosus, lobis triangularibus sparse glanduloso-denticulatis tubo paullo brevioribus; petala oblongo-obovata, circiter 7 mm. longa; stamina petalis et stylo paullo longiora. Fructus ignoti.

Cultivated at the Arnold Arboretum (raised from seed collected by F. N. Meyer in northern Korea in 1906 and received from the U.S. Department of Agriculture under No. 20084 [F. N. Meyer, No. 352a]); specimens collected, May 18, 1918, and June, and September 14, 1920.

Prunus Meyeri seems in all its characters intermediate between *P. Maackii* Rupr. and *P. Maximowiczii* Rupr. and is probably a hybrid between these species, both of which grow in northern Korea and in the same regions, as specimens collected by Mr. Wilson on the Tumen-Yalu divide on two subsequent days show. From *P. Maackii* the supposed hybrid is easily distinguished by the darker and close, not flaky, bark, by the much coarser and double serration of the leaves with acute, not setosely acuminate teeth, by the longer peduncles furnished with bracts, the much larger bracts at the base of the pedicels and by the shorter style. From *P. Maximowiczii* it differs chiefly in the lustrous orange-brown bark of the branches, in the larger leaves glandular-punctate beneath, in the many-flowered racemes with smaller and narrower bracts, in the smaller flowers and in the less densely pubescent calyx and pedicels. If this *Prunus* really is a hybrid, it is like the preceding a hybrid between species of two different subgenera, for *P. Maximowiczii* belongs according to Koehne to the subsect. *Phyllomahaleb* of the subgen. *Cerasus*, while *P. Maackii* belongs to the Ser. *Maackiopadus* of the subgen. *Padus*, though the two groups may be more closely related in spite of Koehne's classification.

Our tree which is now about 6 meters tall with a trunk 12 cm. in diameter has flowered well for several years, but has so far produced no fruits and in this respect resembles *P. Maackii* which in this Arboretum fruits very sparingly while *P. Maximowiczii* is usually well covered with its purple-black lustrous fruits. Though its flowers are not conspicuous *P. Meyeri* is a desirable ornamental tree on account of its vigorous growth, its dense pyramidal habit and its pleasing bright green foliage. The orange-brown lustrous bark of its limbs and branchlets make it attractive in winter.

***Prunus Padus* L. var. *laxa*, var. nov.**

A typo varietatis recedit ramulis gracilibus laxe pendulis foliis angustioribus plerisque obovato oblongis, axillis nervorum subtus ebarbatis, racemis laxis pendulis, putamine minore laeviore vix foveolato. — Arbor glabra ramis patentibus, ramulis junioribus basi tantum minute puberulis: folia elliptico-obovata v. oblongo-obovata, 5–10 cm. longa et 3–4.5 cm. v.

rarius ad 5 cm. lata, acuminata, basi abrupte contracta et glandulis 2 notata, argute serrulata, ea turionum saepe grossius et obtuse serrata, subtus glaberrima, laete vel pallide viridia; petioli graciles, 1-1.8 cm. longi; racemi laxi, pedunculo folia pauca et parva interdum decidua gerente incluso 10-13 cm. longi; flores 1.4 cm. diam; pedicelli 6-13 mm. longi, graciles; petala orbiculari-ovalia, manifeste eroso-denticulata: fructus parvi, purpureo-nigri; putamen 6 mm. longum, costis elavatis brevibus a carina abeuntibus notatum, in media facie fere laevi vel in No. 20078 totum fere laeve.

Cultivated at the Arnold Arboretum (raised from seed collected by F. N. Meyer in northern Korea in 1906 and received from the U.S. Department of Agriculture under Nos. 20082 and 20078; specimens collected: May 6 and Sept., 1915; May 8 and July 25, 1918 (No. 20082 [F. N. Meyer, No. 350a], type); May 8 and July 25, 1918 (No. 20078 [F. N. Meyer, No. 346a])).

This new variety is nearest to *P. Padus* var. *commutata* Dipp. and is perhaps only a form of it; it differs chiefly in its loose pendulous habit, the rather narrow, generally oblong-obovate, quite glabrous leaves, the elongated lax racemes and the much smoother or nearly smooth stone. I have seen no specimen of *Prunus Padus* neither of the European type nor of any of the Asiatic forms with such a smooth stone, except perhaps Wilson's No. 8946 from North Kankyo, the most northern province of Korea. The two plants representing this variety in this Arboretum differ in the stone which is ribbed toward the margin in No. 20082 and nearly smooth in No. 20078, in the petals which are fringed in No. 20082 and nearly entire in No. 20078, and in habit which is looser and more pendulous in No. 20082. The other pendulous form of *P. Padus*, the European *P. Padus* f. *pendula* Hartwig, may be distinguished chiefly by its stouter branchlets, the broader more closely serrate leaves glaucescent beneath, the larger leaves at the base of the racemes, the obovate petals and by the deeply sculptured stone.

Of the other varieties of *P. Padus* occurring in Korea var. *glauca* Nakai differs in the glaucous and var. *pubescens* Regel in the pubescent underside of the leaves, and var. *seoulensis* Nakai in the longer pedicels up to 2 cm. in length, in the long leafy peduncle and in the longer-acuminate leaves.

Two other varieties of *P. Padus* collected by F. N. Meyer in northern Korea were received from the Department of Agriculture, namely, No. 20077 (F. N. Meyer No. 345a) which is *P. Padus* var. *commutata* Dipp., and No. 20079 (F. N. Meyer No. 347a) which is *P. Padus* var. *pubescens* Regel, a variety new to cultivation, as far as I know.

ARALIACEAE

Acanthopanax ternatus, sp. nov.

Frutex bimetralis vel altior, glaber; rami patenti-erecti, satis tenues, pallide cinerei vel brunneo-cinerei, sparse lenticellati, aculeis paucis 4-6 mm. longis validiusculis basi valde dilatatis rectis vel leviter curvatis saepissime geminis et infrapetiolaribus armati vel saepe inermes; gemmae ovoideae, acutiusculae, 1.5-2 mm. longae, brunneae. Folia decidua, petiolata,

3-foliolata; foliola subsessilia vel fere rhombico-elliptica vel ovato-elliptica, apice brevissime acuminata vel acutiuscula et mucronata, basi cuneata, 2-4 cm. longa et 1-2.5 cm. lata, margine dentibus plerisque grossis 1-7 instructa vel praecipue in ramulis floriferis pleraque integra, crassiuscula, supra rugulosa et saturate viridia, subtus pallide viridia, utrinque lucidula, costa media utrinque leviter elevata, venis venulisque supra impressis subtus vix elevatis sed colore distinctis; petioli 1-2.5 cm. vel rarius 3-4 cm. longi. Umbellae in ramulis elongatis terminales, 4-7, centrali majore, rarius solitariae, multiflorae, pedunculatae pedunculis 1-1.5 cm. longis; pedicelli graciles, 5 mm. longi, fructiferi 1 cm. longi; calycis lobi triangulares, minutissimi; petala ovata, acuta vel acuminulata, 2 mm. longi, intus viridi-albi, extus rubescentes; filamenta 1.75 mm. longi; antherae albae, ovalia, 1 mm. longae; styli duo, sub anthesi erecti, 0.5 mm. longi, distincti, in fructu patentibus, leviter curvati, 1.5 mm. longi. Fructus suborbiculatus, valde compressus, 6-7 mm. diam., 3 mm. crassus, nigro-purpureus, dispermus, margine calycis et stylis leviter recurvatis coronatus.

CHINA. Yunnan: mountains near Tsin-kon, on the Mekong River, at high altitude, 1905, *Abbé Monbeig* (seed sent to M. Maurice L. de Vilmorin who sent in 1911 a plant under No. 4280 to the Arnold Arboretum); specimens from this plant collected October 13, 1917, October 14 and 26, 1918 and October 13, 1919 are preserved in the herbarium of the Arnold Arboretum.

This new species seems to be most closely related to *A. trifoliatum* Voss (*A. aculeatum* Witte), which is easily distinguished by the hooked spines, the larger, petioluled, sometimes prickly leaflets, the much longer and slenderer peduncles and pedicels, by the styles being connate to the middle and by the less compressed fruit. It has also some resemblance to *A. spinosum* Miquel, but that species has 5-foliolate leaves and solitary umbels on short lateral spurs.

The plant which was received from M. Maurice de Vilmorin in 1911 has grown into a round-headed bush with upright stems and is now about 2 meters tall. It has proved perfectly hardy at the Arnold Arboretum; the flowers do not open until the beginning of October and the fruits begin to ripen at the end of the same month and are produced only on the central umbel which blooms about two weeks earlier than the lateral umbels. The leaves remain on the branches without change until severe frost sets in in November. The shrub has no special claim to ornamental value except in its dark green, long-persisting leaves which have never suffered from insects or diseases.

CAPRIFOLIACEAE

× *Viburnum Jackii*, hybr. nov. (*V. Lentago* × *prunifolium*).

Frutex altus, ramis gracilibus erecto-patentibus comam rotundam satis densam formantibus; ramuli juniores sparse lepidoto-glandulosi, annotini brunneo-grisei, vetustiores brunnei; gemmae floriferae late ellipsoideales et in rostrum obtusum productae, 0.8-1.2 cm. longae, fuscae, cinereo-lepidotae, foliiferae anguste oblongae, minores. Folia late vel orbiculari-elliptica ad ovata vel elliptica, breviter acuminata, basi late cuneata vel fere rotundata,

4-7 cm. longa et 2.5-5 cm. lata, dense serrulata, supra laete viridia et glabra, subtus sparse fusco-lepidota et pallide viridia, nervis utrinsecus 8-10; petioli 0.8-2 cm. longi, anguste marginati vel ei infra inflorescentiam latius marginati et margine ciliati, initio plana, demum leviter undulata et revoluta. Corymbus 5-9 cm. diam., sessilis vel brevissime pedunculatus; flores 7-8 mm. diam., sessiles vel pedicellati pedicellis 1-3 mm. longis sparse glandulosis ut axes inflorescentiae; stamina corolla longiora. Fructus ellipsoidalis, coeruleo-nigra, pruinosis; putamen compressum, circiter 1 cm. longum et 7 mm. latum.

Cultivated at the Arnold Arboretum, of unknown origin, specimens collected September 24, 1908, June 2, 1909, October 30, 1911, May 28 and September 13, 1912, *J. G. Jack*; September 5, 1918, and June 1, 1920, *A. Rehder*.

This hybrid which was first observed in 1908 in the Arnold Arboretum by Professor J. G. Jack in several individuals of unknown origin, is clearly intermediate between *Viburnum Lentago* and *V. prunifolium* and apparently a hybrid between these two species which bloom at about the same time, with *V. prunifolium* in advance by about a week. From *V. Lentago* it differs chiefly in the less long-acuminate leaves, those below the inflorescence often acutish or obtusish, in their finer serration, in the less pale under side with less conspicuous veinlets, in the less broadly margined petioles with the margin not or little wavy and revolute, although sometimes slightly so at maturity, in the shorter winter-buds and in the denser habit. From *V. prunifolium* it differs in the more or less acuminate leaves with the veins more prominent beneath, in the margined petioles, in the usually sessile, slightly lepidote inflorescence, the smaller, less pure white flowers and in the slenderer branches. As it grows in this Arboretum it forms a handsome rather compact round bush 3-4 m. tall with slender spreading branches, quite different from *V. prunifolium* which is more tree-like with stout rigid branches and often spinescent spurs; it is also different from *V. Lentago* which forms a taller arborescent shrub with a looser head of spreading and arching branches.

Lonicera subsessilis, sp. nov. (Sect. *Isika*, subsect. *Rhodanthae*).

Frutex circiter 2-metralis, glaber; ramuli hornotini demum brunnescentes, annotini grisei v. griseo-brunnei; gemmae conice oblongo-ovatae, acutae, flavo-brunneae, 4-5 mm. longae, perulis circiter 12 glanduloso-ciliolatis. Folia ovata v. elliptico-ovata, acuta v. breviter acuminata, inferiora interdum obtusiuscula, basi late cuneata, inferiora truncata v. rotundata, terminalia angustius cuneata et saepe rhombico-ovata, 3-5.5 cm. longa et 1.6-3.2 cm. lata, margine saepe undulata, utrinque distincte nervoso-reticulata, supra laete viridia, subtus paullo pallidiora, nervis utrinsecus 7-9; petioli 2-5 cm. longi. Flores bini in axillis foliorum superiorum brevissime pedunculati v. fere sessiles, pedunculo vix 1 mm. longo; bractae subulatae minutae, bracteolis breviores; bracteolae in cupulam vix vel leviter bilobatum tertiam partem ovarii aequantem sparse glanduloso-ciliatam connatae; ovaria ad medium vel paullo ultra connata; calycis lobi triangulares, breves, sparse glanduloso-ciliolati; corolla ignota. Baccae intense rubrae,

pleraeque fere ad apicem connatae, 6–8 mm. longae, basi cupula ut videtur succulenta et rubra circumdatae; semina pauca in quoque frutu, irregulariter ellipsoidea, compressa, 5–6 mm. longa, flavida, rugulosa, testa minute granulosa.

KOREA. Prov. Kogen: Kongo-san, cliffs, rare, alt. 667 m., July 5, 1918, *E. H. Wilson* (No. 10436, type; bush 4 ft.); common around Makaenan, Kongo-san, Sept. 13, 1918, *E. H. Wilson* (No. 10722; bush 4–6 ft.; fruit scarlet); Bambutsusu, Kongo-san, Oct. 8, 1917, *E. H. Wilson* (No. 9263; bush 4–6 ft.; fruit scarlet); thickets, Chojanji, Kongo-san, Oct. 16, 1917, *E. H. Wilson* (No. 9275; bush 5–7 ft.; fruit scarlet).

This new species is most closely related to *L. Maximowiczii* Rupr. which also grows on Kongo-san, but is easily distinguished by the longer, long-acuminate, more or less pubescent leaves, by the slender peduncles, and by bractlets connate into two distinct pairs. In its glabrous reticulately veined leaves *L. subsessilis* resembles the closely related *L. Chamissoi* Bge. which differs, however, in the generally oval and obtusish, usually nearly sessile leaves, in the slender peduncles, the very small bractlets connate into distinct pairs, and in the smaller and more numerous seeds of the fruit.

Young plants of *L. subsessilis* are growing in this Arboretum and from these we shall probably soon be able to supply the description of the flowers which, however, as we know them do not present very marked differences in the species of the subsect. *Rhodanthae*.

Lonicera demissa, spec. nov.

Frutex 1–4-metralis, satis densus, ramis divaricatis patentibus subregulariter bifarie ramulosus; ramuli graciles, tenues, accumbenti-villosi, purpurascens, annotini glabri, cinerei, anguste fistulosi; gemmae ovatae, pallide brunneae, perulis orbiculari-ovatis apice rotundatis basalibus acutis exceptis vel ovatis et acutiusculis, margine ciliato excepto glabris. Folia obovata vel elliptico-obovata, in turionibus saepe elliptica vel anguste elliptica, acuta vel obtusiuscula et mucronulata, basi cuneata, 1.5–3 cm. longa et 0.8–1.8 lata, supra opace viridia et accumbenti-pilosa, subtus pallide viridia, longius et densius accumbenti-pilosa praesertim ad nervos, nervis utrinsecus 3–5; petioli pilosi, 1–2 mm. longi. Flores bini, pedunculati pedunculis 0.6–1.2 cm. longis erectis; bracteae subulatae, 4–5 mm. longae, ovario duplo longiores, pilosae; bracteae ovalia, dimidium ovarium paulo superantes vel ovarium fere aequantes, longe ciliatae et sparse pilosae; sepala rotundata, brevina, cilata, interdum parvissime glandulosa; corolla initio albida, mox lutescens, profunde bilabiata, circiter 1 cm. longa; tubus limbo duplo brevior, manifeste gibbosus, intus pilosus; labium anticum lineari-oblongum, reflexum, posticum erectum, apice breviter lobatum lobis ovalibus 2 mm. longis subaequalibus, intus glabrum; stamina labium posticum paulo superantia, filamentis infra medium pilosis, antheris lineari-oblongis; stylus corolla brevior, deflexus, usque ad apicem longe pilosus, stigmatibus capitatis; ovaria distincta, subglobosa, sparse breviter pilosa et sparse glandulosa, 3-loculare loculis biovulatis. Baccae distinctae, globosae, 6–9 mm. diam., intense rubrae, glabrae; semina pauca, ovalia, compressa, minute punctulata, flavo-brunnea.

JAPAN. Suruga prov.: Fuji-san, northern slopes, woods, common, 1000 m. alt. June 1, 1914, *E. H. Wilson* (No. 6908, bush 2-4 m. tall and as much through; flowers yellow). Kai prov.: Yatsugadake, forests, common, alt. 1600-2300 m., September 17, 1914, *E. H. Wilson* (No. 7539; bush 1-2 m., much branched, fruit brilliant scarlet).

This new species is closely related to *L. chrysantha* Turcz. and *L. Morrowii* A. Gray; from both it is distinguished at the first glance by its much smaller leaves, smaller flowers and smaller fruits. The chief characters in which *L. chrysantha* differs are the larger, elongated and pubescent winter-buds, the much larger leaves, the larger flowers, shorter stamens, shorter bractlets, the densely glandular and scarcely pubescent usually ovoid ovary, while *L. Morrowii* differs chiefly in the larger, generally oblong leaves, larger flowers with deeply divided upper lip, shorter stamens with glabrous filaments and in the densely pubescent longer bractlets.

Lonicera demissa was introduced into cultivation by Mr. Wilson who sent seeds in 1914 from Yatsugadake. The plants raised at the Arnold Arboretum have proved perfectly hardy and flowered for the first time in 1919 and more profusely in 1920. Though the shrub has perhaps less claim than most of the related species to ornamental qualities, the dense habit and the bright green foliage are pleasing features and the brilliant scarlet fruits, when produced in abundance, will probably make the shrub attractive in autumn.

MISCELLANEOUS GENERA

Physocarpus intermedius Schneid. f. *parvifolius*, forma nov.

A typo recedit statura humiliore, ramulis congestis adscendentibus, foliis et floribus minoribus. — Frutex humilis, ramis erectis, ramulis congestis suberectis dense foliosis praeditus; folia minora, ovata ad obovata, acuta, basi cuneata v. rarius rotundata, ramulorum floriferorum 0.8-2 cm., turionum ad 4.5 cm. longa, breviter lobulata; flores minores; bractae persistentes; calyx extus glaber; sepala triangularia, margine et intus villosula; petala elliptica, 3 mm. longa, extus medio rubescentia, in alabastro rosea; stamina petalis paulo longiora, antheris fusco-purpureis; carpella 3, rarius 4, villosa, stylis stamina subaequantibus.

Cultivated at the Arnold Arboretum; specimens seen: Capitol Nurseries, Topeka, Kansas, June 1918, J. H. Skinner & Co. (type); Stark Bro's Nurseries, Louisiana, Missouri, June 10, 1918; Arnold Arboretum, June 19, 1920.

This form is very distinct in its habit and in the smallness of all its parts from *P. intermedius* with which it agrees in the more important morphological characters. As it grows in this Arboretum it forms a low shrub now about one meter tall with many upright stems each with numerous rather short ascending branchlets densely clothed with small, bright green leaves. The small pinkish flowers are borne in dense clusters 1.5-2.5 cm. in diameter.

The dense, regular, and distinctly upright habit, the pleasing bright green color of its small foliage and the pinkish flower clusters make this new variety attractive and valuable as a distinct ornamental shrub.

(To be continued)